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ABSTRACT

As the second report on the postcensal survey, educational and training backgrounds of scientific and engineering manpower are analyzed on the basis of questionnaire responses from individuals covering 45 professional and technical occupations and college-graduate groups in the 1960 Decennial Census of Population. A total of 40 tables and 5 charts is presented with social and demographic characteristics analyzed. The report is concerned with the following topics: effects of age, sex, and social and occupational origins in determining educational attainment; relationships between attendance of parochial, private, and public elementary and high schools on subsequent education; dependence of school curricula and class sizes on education attainment; analyses of fields of study for higher degree and for each degree received; financial supports of undergraduate and graduate studies; evaluation of the most important support in terms of occupation group, age, sex, and educational status; contributions of channels of training to job qualifications, and the subject of supplementary training in nondegree programs. Included in the appendices are the questionnaire used; a discussion of the postcensal study-data collection, processing, and tabulating; and ten additional fields of specialized study tabulations for the 1962 sample group. (CC)

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Report No. 104

the education and training of America's scientists and engineers: 1962

by
Seymour Warkov
and
John Marsh

National Opinion Research Center / UNIVERSITY OF CHICAGO

OCTOBER, 1965

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by

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Related Postcensal Studies

Seymour Warkov, with the assistance of Sanford Abrams and John Marsh. AMERICA'S SCIENTISTS AND ENGINEERS: EMPLOYMENT CONDITIONS, 1960 AND 1962. Washington, D. C.: National Science Foundation (in press).

Mildred A. Schwartz. THE UNITED STATES COLLEGE-EDUCATED POPULATION: 1960. Report No. 102. Chicago: National Opinion Research Center, 1965. Multilithed.

PREFACE

The need for information on the nation's scientific and engineering manpower resources has grown sharply in the last few years. Policy planners and managers involved in developing and administering programs dealing with such diverse subjects as research and development, national defense and security, space, health, education, and economic growth have become increasingly concerned about the availability of adequate and accurate information on these human resources.

In 1957 a special advisory panel appointed by the National Science Foundation and the President's Committee on Scientists and Engineers identified the requirements and formulated a program of scientific manpower data to meet needs. The findings, issued by NSF in the report A Program for National Information on Scientific and Technical Personnel (NSF 58-28), became the basis for many of the data collection and study programs subsequently sponsored by NSF. One of the projects recommended in this report as highly urgent was "a special direct survey of a large sample of the persons recorded in the 1960 Census enumeration as college graduates or as persons currently or last employed in scientific and technical positions, whether college graduates or not, to determine relationships between training and subsequent occupations."

Planning of this project, known as the Postcensal Survey of Professional and Technical Manpower, was initiated by NSF in 1960 and by data collection in 1962, when records from the decennial Census became available. In addition to the present report, two other reports have been prepared. The first study, America's Scientists and Engineers: Employment Conditions, 1960 and 1962, is being published by the National Science Foundation. The other report, The United States College-Educated Population: 1960 by Mildred A. Schwartz, was published by the National Opinion Research Center. Additional special reports over the next few years are also expected.

Because this report extends the work reported in the study to be published by NSF, it is appropriate to indicate here that the first study

--described the sample of 1960 scientists and engineers by age, sex, and education and considered occupational group differences in citizenship, marital status, region of residence, and intergenerational occupational mobility in terms of these compositional factors;

--analyzed occupation group differences in 1960 by class of worker status, length of employment with the 1960 organization, and industrial classification;

--documented occupational differences in extent of recruitment to the 1960 occupation group from other occupation groups and strata as indicated by occupational affiliations at age twenty-four;

--determined how many 1960 scientists and engineers were participating in the experienced civilian labor force in 1962, compositional differences in rates of withdrawal over the approximately two-year period, and occupational affiliations of workers changing occupations;

--described the class of worker differences, industrial settings for major employment, years with the 1962 employer, hours worked weekly, etc.;

--analyzed the two most time-consuming work activities in the major employment of scientists and engineers and the compositional differences in these major work roles; also described the entire range of work activities encompassed by scientific and engineering employment;

--considered occupation group, education, sex, and age as factors determining the median salary rates of scientists and engineers in their major 1962 employment and described the additional sources of professional income contributing to their 1961 earnings.

Acknowledgments for the work and effort involved in undertaking and completing this study are numerous. The organizations primarily involved were the National Science Foundation, which provided the primary support and overall guidance for the study, the National Opinion Research Center of the University of Chicago, which servedas the secretariat in planning the survey and was primarily responsible for the analysis of the survey data and preparation of the study reports, and the Bureau of the Census, which carried out the actual survey operations. Other Federal agencies that contributed financial assistance and advice included the Bureau of Labor Statistics, the U. S. Office of Education, the National Institutes of Health, and the Veterans Administration.

In addition to the organizations themselves, a number of individuals in these organizations contributed substantially in carrying out this study, as follows:

National Opinion Research Center.--Seymour Warkov, Senior Study Director, had major responsibility for all phases of the project at NORC, assisted by Sanford Abrams and John Marsh, under the general direction of Peter H. Rossi, Director of NORC. Mildred A. Schwartz prepared the report on the 1960 college-educated population.

Bureau of the Census.--Stanley Greene, Chief, Economics Statistics Branch, Population Division, had primary responsibility for carrying out the survey operations and reviewing the tabulations prepared, assisted by John Priebe. David L. Kaplan, Assistant Chief, Population Division, assisted in the planning of the survey, the design of the survey questionnaire, and the selection of the appropriate sample. Contributions were also made by William J. Milligan and Stuart Garfinkle, formerly of the Bureau of the Census, and in general, by various staff members of the Decennial Operations Division, who were concerned with the programming and tabulating of the survey data.

National Science Foundation.--The Postcensal study was carried out by the Manpower and Education Studies Section, Thomas J. Mills, Head, in the Foundation's Office of Economic and Manpower Studies, Jacob Perlman, Head. Robert W. Cain, Study Director, and Norman Seltzer, Associate Study Director, Manpower Studies Group, were directly involved in all phases of

the study, from the planning stage through the operations to the review and evaluation of the prepared reports. In addition, Mr. Seltzer served as co-ordinator for all the organizations participating in the project.

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CHAPTER 1

INTRODUCTION

This research concerns the education and training of America's scientific and engineering manpower.

Despite their critical importance to the well-being of the nation, there are many gaps in the present state of knowledge about engineers, scientists, other professional workers, and the extent to which college trained personnel are employed in scientific and technical occupations. To meet the need for additional information, the Advisory Panel to the National Science Foundation and the President's Committee on Scientists and Engineers recommended "a special direct survey of a large sample of persons recorded in the 1960 Census enumeration as college graduates or as persons currently or last employed in scientific and technical positions, whether college graduates or not, to determine relationships between training and subsequent occupation" (A Program for National Information on Scientific and Technical Personnel, 1958).

Seeking to implement this recommendation, the National Science Foundation requested that the National Opinion Research Center prepare a planning statement[1] on a series of post-enumeration studies of scientific and professional workers and college graduates. The planning statement provided the basis for implementing the recommendation of the Advisory Panel and resulted in the Postcensal Survey of Scientific and Technical Manpower.

The Sample

Sample selection, data collection, data processing, and the tabulating of data presented in this report were undertaken by the Bureau of the Census.[2] The Survey employed as its basic reference point the

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[1] The statement was prepared by James A. Davis and Peter H. Rossi.

[2] A detailed description of these procedures is given in "The Postcensal Study-Data Collection, Processing and Tabulating," by Stanley Greene and David L. Kaplan, in Proceedings of the Social Statistics Section (Washington, D. C.: American Statistical Association, 1963), pp. 154-63 (reproduced as Appendix 2 of this report).

1960 Census of Population, which classified one-fourth of the population by a number of key characteristics including occupation and education. Workers were classified occupationally by the Bureau of the Census on the basis of responses given to the question, "What kind of work was he doing?" This information was provided by the member of the household completing the Household Questionnaire for the 1960 Census of Population and Housing. These data were stored in the Census 25 per cent sample file, which, in turn, comprised the source for the sampling frame used for this survey.

Using the Decennial Census as the frame, samples ranging in size from 1,000 to 4,000 persons per occupation were drawn from some forty scientific, technical, and professional occupations classified as "Professional, Technical and Kindred" under the three digit occupational code employed by the Bureau of the Census. Occupations were sampled in sufficient number to assure the minimum of 1,000 cases per occupational title for the initial mail-out questionnaires.

For example, the original number of cases of mining engineers was set at 1,000 cases. Because the basic universe for the 1960 experienced civilian labor force was not yet known, but had to be estimated at the time the sample was to be drawn for this survey, a liberal sample ratio of mining engineers was set to assure that a sufficient number of sampling cases would be selected from the Census 25 per cent sample file. The sampling fraction was set at one-half and yielded a sample count of 1,526 cases. Then the sub-sampling ratio was set at 0.65531, resulting in a final sample selection of 1,000 mining engineers.

The major classes of persons comprising the universe of this survey are in the professional and technical occupations; this report covers only those professional persons in the scientific and engineering occupations. The largest class of persons in the universe was comprised of persons who were reported as being in the experienced civilian labor force in some forty specified professional and technical occupations in 1960 (see Appendix 2). In addition to these professional and technical workers, the survey included a sample of persons who had completed at least four years or more of college. This college sample was subdivided into seven groups, of which three were in the labor reserve in 1960. They were as follows: females, aged twenty to fifty-four years, with experience in one of the selected professional or technical occupations; others with experience in one of these target occupations; all other persons in the labor reserve. Also, persons in the experienced civilian labor force in all occupations other than those selected for special study in this survey (three groups), and a sample of the remaining noninstitutional civilian population twenty years old and over.

Field work was conducted in the spring, summer, and fall of 1962, and self-administered questionnaires were mailed to 71,300 persons selected for study. The mailing operations resulted in a response rate of 72.2 per cent, representing 51,505 completed questionnaires. The detailed listing of occupations and other segments of the study population is shown in Appendix 2, as are the sample size and response rate for each occupation and component of the universe.

The Questionnaire

Each respondent was asked to complete an eight-page self-administered questionnaire (reproduced in Appendix 1). Minor variations were necessary to adapt the basic questionnaire--first, to those persons who were classified as "technicians" in 1960, and second, to those college trained persons who were in the 1960 experienced civilian labor force but not in the scientific, technical, or other professional occupations selected for intensive study, and/or those persons reported by the 1960 household informant to have completed four years of college but who were out of the experienced civilian labor force.

The final version of the questionnaire sent to the respondents after pretesting conducted by the National Opinion Research Center and then by the Bureau of the Census consisted of four sections.

Section I considered current (1962) employment and asked questions about employment status, and if working, about the respondent's occupation, industry, type of employing organization, earnings, job activities, work relationships, work attitudes, and the holding and nature of a second job.

Section II dealt with employment status as of April, 1960 (when the Decennial Census was taken), and the respondent's first full-time job upon reaching age twenty-four (an age when most persons have completed their formal education).

Section III sought information about the education and training of respondents, asking questions about colleges attended, field of study, type of degree granted, and year work ended. Other topics covered here included sources of financing of post-high school training (distinguishing between undergraduate and graduate level support) and other types of training respondents might have received, such as apprenticeships, company training programs, correspondence courses, military training applicable to civilian occupations, and the like.

Section IV secured such background information as age, sex, residence, father's occupation, marital status, ages and sex of children, and membership in professional societies or associations.

Reports on the Postcensal Survey

This is the second of three reports in preparation at the National Opinion Research Center on behalf of the National Science Foundation.[3] These reports are based on a tabulation plan that was prepared at NORC more than two years ago at the time the Survey entered the field. Knowing that a major source of occupational differentiation can be found in the age, sex, and educational composition of these occupations, the basic plan called for preliminary tabulations from the Census Bureau in terms of these three statistical "controls."

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[3] The first report is Warkov (in press); the third, Schwartz (1965).

Furthermore, the first report was prepared with the purpose of providing a broad overview of the employment conditions in 1960 and 1962 of that critical segment of the sample comprised of America's engineers and scientists. This second report sketches certain aspects of the education and training of these same scientists and engineers. As a result of these considerations, the age, sex, and educational correlates of employment and training were prepared for five broad occupation groups. The five occupation groups[4] and the detailed occupations subsumed by each grouping were as shown in the accompanying table (p. 8).

While the data analyzed in the first report were all collected in 1962, they conveyed a time perspective in that the story they told covered two points in time: the first described the 1960 conditions of employment of scientists and engineers in greater detail than was heretofore available from the occupational and employment statistics routinely gathered by the Bureau of the Census for the entire experienced civilian labor force: the second described in even fuller detail the 1962 conditions of employment and job activities of persons classified as engineers and scientists by the Bureau of the Census in 1960.[5]

In general, these scientific and engineering occupation groups showed systematic differences in the patterns of employment behavior of

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[4] The occupation groups include the academic titles that are normally associated with each occupational grouping. Thus professors and instructors of engineering were included among the engineering occupation group. Similarly, professors and instructors of biological sciences were subsumed by the occupation group classification covering biological and agricultural scientists. There was one title, however, that was excluded from the biological scientists grouping, namely professors and instructors of medical sciences. The exclusion was arbitrary, and some readers may have preferred to have them among the biological scientists occupation group that is the subject of this report. Inspection of the special tabulations indicated that the weighted universe estimate for professors and instructors of medical sciences came to 6,584 in number. This group was quite dissimilar to other occupations covered in this report: fully 39 per cent reported "other professional degree" to be their highest one in April, 1960. Among the biological scientist occupation group covered in this report, only 1 per cent reported a professional degree as the highest academic degree secured by 1960 (presumably, a medical degree).

[5] The reader may wish to consult U. S. Bureau of the Census (1963a, b, c; 1964).

OCCUPATION GROUPS USED FOR TABULATIONS OF 1960 AND 1962 CHARACTERISTICS

Occupation Group	Census Occupation Titles in Each Occupation Group
Engineers	Professors and instructors, engineering
	Civil engineers
	Electrical engineers
	Mechanical engineers
	Industrial engineers
	Other engineers: aeronautical chemical metallurgical mining sales NEC[a]
Physical scientists .	Chemists
	Professors and instructors of chemistry
	Geologists and geophysicists
	Professors and instructors, geology and geophysics
	Physicists
	Professors and instructors, physics
	Professors and instructors, natural sciences (NEC)
	Miscellaneous natural scientists
Biological and agricultural scientists	Professors and instructors, biological sciences
	Biological scientists
	Professors and instructors, agricultural sciences
	Agricultural scientists
Mathematicians and statisticians	Professors and instructors, mathematics
	Mathematicians
	Professors and instructors, statistics
	Statisticians and actuaries
Social scientists . .	Professors and instructors, psychology
	Psychologists
	Professors and instructors, economics
	Professors and instructors, social sciences (NEC)
	Economists
	Miscellaneous social scientists

[a] Not elsewhere classified.

their 1960 incumbents along the dimensions outlined above even when these compositional factors of age, sex, and highest academic degree secured were taken into account. Nevertheless, much occupational differentiation could be explained in terms of these three compositional variables. Position in the age structure and sex roles accounted for some of the differentials in employment behavior reported in the first postcensal report; but by far the most important of the three factors was level of education attained by these scientists and engineers. The recipient of the doctorate among those classified by the Census Bureau in these broad occupation groups in 1960, and the worker lacking the minimum of a four-year baccalaureate degree, simply lived in different worlds of work despite their common occupational classification.

For this reason, it is important to learn how these persons prepared for their occupational life and to identify some of the mechanisms that separated out those who were without the four-year degree from others who managed to complete their undergraduate requirements and went on to secure graduate level degrees.

The chapters of this report are as follows:

Chapter 2. Correlates of Educational Attainment.--Describes certain social and demographic characteristics of this sample of engineers and scientists, and considers the effects of age, sex, social and occupational origins in determining educational attainment by 1960.

Chapter 3. Elementary and High School Characteristics.--Analyzes the effects of attendance at parochial, private, and public elementary and high schools on subsequently educational attainment; also, types of school curricula and size of high school graduating class are considered in the same light.

Chapter 4. Fields of Study.--Documents the field of study for the highest degree and for each degree held by scientists and engineers in 1960 and 1962.

Chapter 5. Sources of Support.--Determines the various sources of support employed by scientists and engineers in securing their formal training at the undergraduate and graduate levels. Also, the single most important source of support is evaluated in terms of occupation group, age, sex, and educational status.

Chapter 6. Qualifications for 1962 Employment.--Describes various channels of training considered by scientists and engineers to contribute importantly to their job qualifications; also considers the subject of supplementary training taken in the various nondegree programs of study or preparation.

CHAPTER 2

CORRELATES OF EDUCATIONAL ATTAINMENT

What were the social and demographic characteristics of America's 1960 scientists and engineers? Did they differ in educational attainment? Did social and demographic factors make a difference in the educational attainment of professional workers in critical occupations? These are some of the questions considered in this chapter.

Engineers, physical scientists, biological scientists, social scientists and mathematicians differed extensively in certain social and demographic characteristics. A summary profile of these professional workers (see Table 2.1) includes the following:

Sex.--The engineering occupation group was almost totally male; less than one out of one hundred engineers was female. Six per cent of the physical scientists and 16 per cent of the biological scientists were women. On the other hand, mathematicians and social scientists had considerable female representation (26 per cent and 24 per cent respectively).

Age.--The five occupation groups also varied in terms of age composition: The most "youthful" group consisted of mathematicians, with over four out of ten (41 per cent) younger than thirty-five years of age in 1962; then physical scientists (36 per cent under thirty-five), biological scientists (31 per cent), engineers (30 per cent), and social scientists (26 per cent). A different occupational rank order prevailed in the extent to which workers were concentrated in the older age groups, i.e., forty-five or older. While social scientists were most likely to be over forty-four (fully 41 per cent were), the physical scientists rather than the mathematicians were least likely to be among the older age groups (some 28 per cent of the physical scientists were over forty-four). The remaining three occupation groups--mathematicians, engineers, and biological scientists--fell in the middle; one out of three professional workers in each of these 1960 occupation groups was forty-five or older in 1962.

Marital status.--Men and women had substantially different marital profiles in 1962. Without exception, men were more frequently married than their female counterparts while women more frequently reported separation, divorce, and widowhood. This held true among each of the occupation

TABLE 2.1

SELECTED SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF 1960 SCIENTISTS AND ENGINEERS, BY OCCUPATION GROUP (1960)

(Per Cent)

Occupation Group, 1960	Sex	Age				Marital Status	Social Origins	Weighted Number of Workers
	Male	Under 35	35-44	45-54	55 and Over	Married, 1962	Fathers in PT&K[a] Occupations When Respondent Was Age 16	
Engineers	99	30	37	19	14	93	14	879,742
Physical scientists	94	36	36	17	11	87	18	135,822
Biological scientists . .	84	31	36	19	14	84	18	32,879
Mathematicians .	74	41	26	19	14	78	19	37,733
Social scientists	76	26	33	22	19	79	20	68,331

Total N 1,154,507

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[a] PT&K = professional, technical and kindred occupations.

groups considered in this report even when age group was taken into account. Parenthetically, educational attainment (to be considered in detail below) made little or no difference in the marital profiles of male scientists and engineers, whereas level of education did make a difference in the marital status of women, the proportion married declining with each step up the academic ladder.

Social origins.--If social origins are measured by father's occupation when respondents were sixteen years of age, the data show that 14 per cent of the engineers and from 18 to 20 per cent of the four scientific occupation groups reported that their fathers were in occupations classified by the Bureau of the Census as "Professional, Technical and Kindred."[1]

Having briefly described some of the major social and demographic features of the occupational profile, we turn to the question of educational attainment and consider whether the five occupation groups under review also differed in academic levels of attainment.

Educational Attainment of Scientists and Engineers

That advanced education is a prerequisite for entry to the occupations classified as PT&K is well known. However, it is not known to what extent the scientific and engineering occupations that are part of the PT&K occupational category are differentiated on the basis of the educational origins of their incumbents or to what extent varied educational pathways were followed to these 1960 occupations. In this section we document the movement of engineers, physical scientists, life scientists, mathematicians, and social scientists through the system of higher education, and we specify some of the conditions that facilitated or impeded movement to the next stage of academic attainment.

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[1] The higher the scientists' and engineers' level of academic attainment by 1960, the higher the proportion reporting that their fathers were in PT&K occupations. Furthermore, female scientists reported their fathers were employed in PT&K occupations more frequently than did their male counterparts (See Warkov [in press, Chap. 2]).

How then did the five occupation groups compare on educational attainment? If this is measured by the highest academic degree secured by 1960 by these scientists and engineers, Table 2.2 shows that there were extensive differences among them in the extent to which incumbents of these occupational slots have (1) attended college; (2) taken the baccalaureate; (3) embarked upon graduate work (designated as "bachelor's plus" in tables and text); (4) received the master's degree; and (5) secured the doctorate.

A substantial minority (47 per cent) of the persons coded as engineers by the Bureau of the Census had not received a bachelor's degree by 1960, and over one out of ten (13 per cent) had not even attended college. In contrast, two out of three persons classified as mathematicians or statisticians were at least bachelor's recipients, as were three out of four physical scientists, four out of five biological scientists, and seventeen out of twenty social scientists. As for the occupational rank order in the extent to which the incumbents of these 1960 occupational slots had secured the doctorate, the Ph.D. in engineering was rare, only one out of one hundred carrying these credentials in contrast to three out of ten social scientists. These five occupation groups then differed extensively in their composition as represented by the educational attainment of their 1960 incumbents.

If these percentages are cumulated to indicate the proportion attaining each academic level, the second panel of Table 2.2 shows that at least 96 per cent of the social scientists had some college attendance, as did 88 per cent of the engineers. At least 85 per cent of the former held the bachelor's degree by 1960--only 53 per cent of the engineers did. To contrast the extremes once again, three out of four social scientists went beyond the bachelor's to attend graduate school; only one out of four engineers reported any graduate level training, and so forth. Within each group the next step in educational attainment as measured by the degree secured by 1960 was accompanied by a decline in the proportion of the occupation group that moved to that level. These findings appear to support the proposition that the American system of higher education is a pipeline processing the student material so that progressively fewer persons seek to move on to the next academic level.

TABLE 2.2

EDUCATIONAL ATTAINMENT (1960), BY OCCUPATION GROUP (1960)

(Percentage Distribution and Cumulative Percentage Distribution)

Occupation Group, 1960	Per Cent						Cumulative Per Cent					Weighted Number of Persons[a]
	Educational Attainment											
	No College	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers . .	13	34	29	17	6	1	88	53	25	7	1	862,664
Physical . . scientists.	7	18	23	21	16	16	94	76	53	31	16	131,674
Biological scientists.	6	12	16	16	23	28	94	82	67	51	28	31,540
Mathematicians . . .	13	22	17	18	21	10	87	66	49	31	10	36,512
Social scientists.	4	11	9	13	33	31	96	85	77	64	31	65,091

N 1,127,477

NA, highest degree attained 27,030

Total N 1,154,507

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[a] The Bureau of the Census weighted up and expanded each occupation sample to its 1960 universe representation in the experienced civilian labor force.

Sex Differences in Educational Attainment

Substantial differences obtain in the extent to which women are among the incumbents of these 1960 occupation groups. Examining differences in educational attainment by sex, Table 2.3 shows that among the physical scientists, a slightly greater proportion of women stopped at the bachelor's level in 1960 and twice as many men (16 per cent) as women (8 per cent) held doctorates. In the biological science occupation group, women were overrepresented at the lower levels (pre-bachelor's and bachelor's), but proportionately three times as many men as women held the doctorate. Among mathematicians, the dividing point was represented by the bachelor's degree: beyond this level, men outdistanced women while women were more likely to have the bachelor's or to have stopped short of this degree. No differences are discerned until the master's among the social scientists: interestingly, proportionately more women than men held this intermediate graduate degree in 1960, but 35 per cent of the men held the doctorate in contrast to 19 per cent of the women.

The educational attainment of workers in these five occupations is shown again in Table 2.3 in the form of cumulative percentages. It is evident that sex differences in movement through the educational pipeline importantly influenced patterns of academic development among the four scientific occupation groups.

Initial occupational differences in types of career lines stood out in even sharper relief when men and women were treated separately.

Age Group and Academic Attainment

Whether or not age composition shaped these differences in academic attainment of 1960 scientists and engineers may be considered by inspecting Table 2.4. Of course, these data provide an approximation subject to distortion that only a longitudinal study of cohorts could circumvent. This must be kept in mind when interpreting cross-sectional age-related differences in education attainment of engineers and scientists at this

TABLE 2.3

EDUCATIONAL ATTAINMENT (1960), BY SEX AND OCCUPATION GROUP (1960)

(Percentage and Cumulative Percentage Distribution)

Occupation Group, 1960	Sex	Per Cent						Cumulative Per Cent					Weighted Number of Persons
		Educational Attainment											
		No College	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers	Men	12	34	29	17	6	1	87	53	24	7	1	856,419
Physical scientists .	Men	7	18	23	21	16	16	94	76	53	32	16	123,046
	Women	9	14	31	24	15	8	91	77	46	22	8	8,628
Biological scientists	Men	6	10	14	15	24	31	94	84	70	55	31	26,533
	Women	8	20	24	17	19	12	92	72	48	31	12	5,007
Mathematicians . .	Men	8	21	16	20	23	12	92	71	56	35	12	26,886
	Women	26	24	22	12	15	3	74	51	29	18	3	9,626
Social scientists	Men	4	11	7	14	30	35	97	85	78	64	35	49,603
	Women	6	10	12	10	43	19	95	84	72	62	19	15,788

N	1,127,477
NA, highest degree attained	27,030
Total N	1,154,507

TABLE 2.4

EDUCATIONAL ATTAINMENT (1960) FOR SELECTED AGE GROUPS (1960), BY OCCUPATION GROUP (1960)

(Percentage and Cumulative Percentage Distribution)

Occupation Group, 1960	Age, 1960	Per Cent						Cumulative Per Cent					Weighted Number of Persons
		Educational Attainment											
		No College	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	Some College	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers	25-34	7	27	35	23	8	1	94	66	31	9	1	278,838
	35-44	12	33	30	17	7	1	88	55	25	8	1	288,640
	45-54	19	43	21	13	5	1	82	40	19	7	1	151,479
Physical scientists .	25-34	4	15	25	25	17	14	96	81	56	31	14	47,098
	35-44	7	13	24	20	17	20	93	80	57	37	20	42,145
	45-54	12	21	19	16	16	16	88	67	48	32	16	20,378
Biological scientists	25-34	3	8	19	19	28	23	97	89	70	51	23	9,472
	35-44	4	7	15	13	24	37	96	89	74	61	37	10,212
	45-54	8	12	12	13	22	33	92	80	68	55	33	5,395
Mathematicians . . .	25-34	5	17	21	26	24	7	95	78	57	31	7	11,994
	35-44	10	21	15	14	27	14	91	70	55	41	14	9,361
	45-54	18	22	13	12	20	15	82	60	47	35	15	6,105
Social scientists . .	25-34	2	8	12	20	37	21	98	90	78	58	21	17,833
	35-44	3	7	7	8	36	38	97	90	82	74	38	20,621
	45-54	5	13	7	9	32	36	95	83	76	67	36	13,527

N	933,098
Age groups excluded: 20-24, 55 and over, NA degree	221,409
Total N	1,154,507

one point in time (April, 1960). The table suggests that an upgrading in educational attainment occurred at certain levels but not at others, and in certain age groups but not in others. Considering each occupation group separately, we see the following:

Engineers.--For each of the three age groups: twenty-five to thirty-four, thirty-five to forty-four, and forty-five to fifty-four, there was almost universal exposure to some college-level training. Even so, more younger engineers attended college (94 per cent) than did the older ones (82 per cent). There was a dramatic increase in the proportion who were bachelor's recipients: two-thirds of the younger engineers in contrast with two-fifths of the older engineers were college graduates by April, 1960. In addition, relatively more younger men entered graduate school or took the master's degree: rates of entry into graduate school were lower among the engineers aged thirty-five to forty-four and even more so among those aged forty-five to fifty-four.

Physical scientists.--Cumulative percentage distributions show that, like the engineers, physical scientists in every age group had almost universal exposure to college and a slight age-related increase in college exposure as well (96 per cent among the younger physical scientists as compared with 88 per cent among the older ones). Like the engineers, an increase in rates of college completion occurred if older physical scientists, aged forty-five to fifty-four, are compared with others. On the other hand, no differences appeared among the physical scientists aged twenty-five to thirty-four and thirty-five to forty-four, while there were differentials in attainment among the engineers in these two age grades. Furthermore, rates of entry into graduate school have maintained the same pattern, physical scientists aged forty-five to fifty-four entering graduate school by 1960 less frequently than their younger counterparts aged twenty-five to thirty-four or thirty-five to forty-four. Like the engineers, however, no age-related differences were discernible in the chances of holding the master's or the doctorate by 1960.

Mathematicians.--A different pattern occurred among mathematicians: there were age differences in levels of educational attainment that were similar to those found among engineers but unlike the pattern characterizing the physical and biological scientists.

Specifically, the panel presenting cumulative percentage distributions shows that the proportion of each age group who entered college, took the bachelor's degree, and entered graduate school is directly related to age: in each case, proportionately more mathematicians aged twenty-five to thirty-four reached these levels than those in the group aged forty-five to fifty-four. On the other hand, those aged twenty-five to thirty-four have not attained the doctorate as frequently as their older counterparts in this occupation group despite their higher rates of completion farther down the academic line. Again, the time factor explains this discrepancy.

In each of the four occupation groups reviewed to this point, a different pattern of educational attainment was found when the age groups were compared on their absolute levels of achievement.

Social scientists.--Table 2.4 shows that at every academic level and in every age group, these professional workers had even higher rates of academic attainment than the physical scientists. There were few important age differences among the social scientists in levels of attainment: at each degree level those in the group aged forty-five to fifty-four were similar to their younger counterparts in the proportion who entered college, took the baccalaureate, or started graduate study.

Educational Attainment and Occupational Origins

Continuing to focus on the problem of academic attainment of persons in these five occupation groups, this section considers whether the first full-time civilian job secured at age twenty-four was related to the level of education achieved by 1960.[2] While the selection of any one point in the working career is necessarily an arbitrary choice, this point in time should eliminate the full-time job that may have been incidental to the student's long-term career plans.

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[2] See Warkov (in press, Chap. 5) for the discussion of occupational origins of scientists and engineers.

Further light is shed on conditions affecting educational advancement if persons whose occupational affiliation at age twenty-four conforms to their 1960 occupation group are compared with those workers who differ in their occupational affiliations at these two points in time.

The data are presented in the form of cumulative percentage distributions in Table 2.5. Examination of the cumulative percentage distributions in each of the five occupation groups reveals the following:

1. In every occupation, and at every level of educational attainment, persons with jobs at age twenty-four in occupations below the PT&K stratum were less likely to hold the bachelor's, enter graduate school, take the master's, or hold the doctorate by 1960 than their counterparts whose jobs were in their 1960 occupation or in other PT&K occupations.

2. Comparisons between those holding jobs at age twenty-four in the same occupation and those in other PT&K occupations yielded a number of differences depending on the occupation and the educational level. Among the four scientific occupations, those holding jobs in other PT&K occupations reported slightly higher rates of attainment at every level save the doctorate. Among the engineers, the reverse held true.

The finding that 1960 scientists and engineers whose full-time jobs at age twenty-four were in occupations below the PT&K stratum had attained lower academic levels than their counterparts with jobs within the PT&K stratum will require additional study. Persons holding such jobs had farther to "travel" to attain their 1960 occupational position. The handicap imposed by full-time civilian employment below the PT&K stratum presumably was reflected in lower levels of attainment by 1960.

The second finding is problematical: On the face of it, there is little reason to expect that persons moving into their 1960 occupation group from other PT&K occupations should show higher rates of attainment at every level (except the doctorate) than their counterparts in each of the four scientific occupation groups who maintained their early occupational affiliation.

TABLE 2.5

EDUCATIONAL ATTAINMENT (1960), BY TYPE OF OCCUPATION GROUP AT AGE TWENTY-FOUR AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group, 1960, and Type of Occupation Group at Age Twenty-four	Cumulative Per Cent				Weighted Number of Persons
	Educational Attainment				
	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers					
Same	65	30	9	1	497,954
Other PT&K[a] . . .	51	26	9	2	113,623
Other	31	13	3	0	203,088
Physical scientists					
Same	80	56	34	18	86,537
Other PT&K . . .	83	64	40	18	23,361
Other	59	31	12	4	15,698
Biological scientists					
Same	87	71	56	34	16,507
Other PT&K . . .	89	75	58	29	7,474
Other	78	58	34	14	4,772
Mathematicians					
Same	75	54	36	14	16,502
Other PT&K . . .	84	71	47	11	7,992
Other	43	28	12	3	8,543
Social scientists					
Same	89	81	69	39	25,434
Other PT&K . . .	93	89	76	32	22,305
Other	72	56	41	20	13,278

N	1,063,068
Not employed, age 24	19,198
NA, highest degree attained	72,241
Total N	1,154,507

[a] PT&K = professional, technical and kindred occupations.

Closer inspection of the cumulative percentage distributions shows that the differences between "PT&K Occupation Group Different" and "Occupation Group Same" are greatest in each of the four scientific groups in favor of "PT&K Occupation Group Different" among those who have entered graduate school but held no advanced degrees by 1960. One interpretation that accords with these data and is subject to confirmation or rejection when additional analysis is undertaken would go as follows: Scientists moving into their 1960 occupation group from other occupations in the PT&K stratum incur certain "costs" in switching occupations, the most important one being the necessity for additional formal training. Since entry into their 1960 scientific occupation group from another PT&K occupation already implies both college level training and receipt of a bachelor's degree, it appears that such persons enrolled for additional college and graduate level training.[3]

Sex Roles: Their Effects on Educational Attainment

Directing our attention once more to the educational consequences of differential occupational origins, we have shown that sex roles importantly contributed to differences in educational level earlier in this report. Whether sex roles alter or modify the finding that movement into the 1960 occupation from other occupations below the PT&K stratum resulted in lower levels of academic attainment by 1960 may be determined from data shown in Table 2.6. We learn that:

a) Controlling for occupational origins, men experienced higher levels of educational attainment in thirty-nine out of forty-eight possible comparisons in the four scientific and mathematical occupation groups in terms of completion of the

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[3] Because the data in their present form do not permit a direct control for year in which work was completed for the highest degree held, it is evident that our findings may be confounded because an unknown proportion of these scientists and engineers received their bachelor's after age twenty-four. Here, too, additional cross-tabulations are anticipated to clarify this pattern of relationships.

TABLE 2.6

EDUCATIONAL ATTAINMENT (1960), BY TYPE OF OCCUPATION GROUP AT AGE TWENTY-FOUR, SEX, AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Sex	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers						
Same	Male	65	30	9	1	495,988
	Female	45	31	19	3	1,966
Other PT&K[a]	Male	51	26	9	2	12,025
	Female	57	31	20	2	1,597
Other	Male	25	10	2	0	250,944
	Female	17	7	4	0	2,155
Physical scientists						
Same	Male	80	56	35	19	81,436
	Female	85	48	23	8	5,101
Other PT&K	Male	79	61	37	15	20,272
	Female	82	57	34	9	1,999
Other	Male	58	30	11	4	15,103
	Female	81	58	16	6	685
Biological scientists						
Same	Male	88	75	61	38	14,035
	Female	78	47	31	12	2,472
Other PT&K	Male	91	80	63	33	5,968
	Female	81	60	40	15	1,608
Other	Male	76	52	35	15	4,230
	Female	45	32	21	8	317
Mathematicians						
Same	Male	80	62	42	18	12,478
	Female	59	27	19	4	4,024
Other PT&K	Male	84	73	48	13	6,036
	Female	82	59	39	5	2,046
Other	Male	51	34	15	5	6,137
	Female	24	14	5	0	2,303
Social scientists						
Same	Male	90	83	72	44	20,398
	Female	85	72	61	21	5,036
Other PT&K	Male	92	86	72	39	14,861
	Female	96	86	76	21	6,874
Other	Male	74	64	49	17	11,272
	Female	66	48	37	13	2,577

N	1,011,943
Not employed at age 24	19,198
NA, highest degree attained	123,366
Total N	1,154,507

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[a] PT&K=professional, technical, and kindred.

bachelor's, entry into graduate school, receipt of the master's, and receipt of the doctorate. The cumulative percentage distributions indicate that women consistently outdistanced men among those physical scientists entering their 1960 occupation from jobs held at age twenty-four below the PT&K stratum. Of course, some of the men held blue-collar jobs, while all the women were in white-collar work in those first full-time civilian jobs.

b) Among the men, no modification in the original relationship between occupational origins and subsequent educational attainment was found in examining cumulative percentage distributions. Similarly, with the exception of attainment at the lower academic levels among the physical scientists, women entering their 1960 occupations from below the PT&K stratum showed lower educational levels of achievement than their counterparts from within the PT&K stratum; while women entering their 1960 occupation from other PT&K occupations showed slightly higher levels of academic advancement than their female counterparts who were in their 1960 occupation by age twenty-four.

Age Differences in the Educational Consequences of Occupational Origins

Whether or not age group modified the relationship between occupational origins and subsequent educational attainment by 1960 is considered here. Each 1960 occupation group is treated separately in the five panels of Table 2.7.

Engineers.--Inspection of the cumulative percentage distributions in Panel A shows that younger engineers were more advanced academically than older engineers, provided that their occupational origins lay in engineering occupations at age twenty-four or were nonprofessional; but age differences in academic attainment were negligible among those whose job at age twenty-four was classified as PT&K but nonengineering. The strongest age differences obtained among those starting as engineers, and it is quite possible that this educational impetus will be sustained. The reason for the near absence of an age relationship with academic advancement among engineers of PT&K nonengineering origins probably is attributable to the fact that a majority held jobs in the technical occupations at age twenty-four. Despite the age variations shown in these panels, the more important

TABLE 2.7

EDUCATIONAL ATTAINMENT (1960), BY TYPE OF OCCUPATION

(Cumulative Percentage Distribution)

a) Group at Age Twenty-four, Age in 1960, and Occupation Group in 1960: Engineers

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Age, 1960	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment, 1960				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Same	25-34	73	35	11	1	203,077
	35-44	68	31	10	2	149,031
	45-54	51	24	7	1	59,930
Other PT&K[a] occupations	25-34	56	29	7	2	26,706
	35-44	53	26	9	1	45,117
	45-54	51	29	13	3	23,430
Other	25-34	41	17	3	0	40,009
	35-44	34	14	3	0	82,545
	45-54	28	15	3	0	55,109

N	684,954
Not employed, age 24	11,868
Age group exclusions: 20-24, 55 and over NA, degree	183,920
Total engineers	879,742

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[a] PT&K = professional, technical and kindred.

TABLE 2.7--Continued

b) Group at Age Twenty-four in 1960, and Occupation Group in 1960: Physical Scientists

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Age, 1960	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment, 1960				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Same	25-34	83	59	34	16	35,767
	35-44	83	59	41	24	25,941
	45-54	71	51	40	23	10,402
Other PT&K[a] occupations	25-34	91	68	41	10	6,502
	35-44	89	67	43	18	7,979
	45-54	75	60	36	14	5,137
Other	25-34	47	21	6	0	5,118
	35-44	61	34	14	7	6,605
	45-54	52	27	10	4	3,897

N	107,348
Not employed, age 24	2,903
Age group exclusions:	
20-24, 55 and over	
NA, degree	25,571
Total physical scientists	135,822

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[a] PT&K = professional, technical, and kindred.

TABLE 2.7--Continued

c) Group at Age Twenty-four, Age in 1960, and Occupation Group in 1960: Biological Scientists

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Age, 1960	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment, 1960				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Same	25-34	90	71	55	27	6,202
	35-44	88	78	68	46	5,279
	45-54	84	72	62	42	2,098
Other PT&K[a] occupations	25-34	91	78	54	19	1,739
	35-44	93	80	64	33	2,651
	45-54	86	76	61	32	1,895
Other	25-34	79	44	22	4	1,043
	35-44	76	53	36	13	1,729
	45-54	69	50	34	18	1,070

N	23,706
Not employed, age 24	1,346
Age group exclusions:	
20-24, 55 and over	
NA, degree	7,827
Total biological scientists	32,879

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[a] PT&K = professional, technical, and kindred.

TABLE 2.7--Continued

d) Group at Age Twenty-four, Age in 1960, and Occupation Group in 1960: Mathematicians

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Age, 1960	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment, 1960				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Same	25-34	83	59	33	10	7,051
	35-44	80	66	59	26	3,423
	45-54	61	48	44	26	1,793
Other PT&K[a] occupations	25-34	91	74	43	5	2,536
	35-44	85	72	52	13	2,287
	45-54	83	71	56	21	1,740
Other	25-34	49	33	11	1	2,037
	35-44	48	32	13	4	2,967
	45-54	42	27	13	4	2,445

N	26,279
Not employed, age 24	1,325
Age group exclusions: 20-24, 55 and over NA, degree	10,129
Total mathematicians	37,733

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[a] PT&K = professional, technical, and kindred.

TABLE 2.7--Continued

e) Group at Age Twenty-four, Age in 1960, and Occupation Group in 1960: Social Scientists

Occupation Group (1960) and Type of Occupation Group at Age Twenty-four	Age, 1960	Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment, 1960				
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Same	25-34	91	80	63	27	9,476
	35-44	95	90	84	52	8,277
	45-54	88	83	80	60	3,096
Other PT&K[a] occupations	25-34	92	84	66	19	4,391
	35-44	97	90	82	40	6,293
	45-54	92	86	75	35	6,263
Other	25-34	81	61	33	7	3,089
	35-44	75	65	53	18	5,019
	45-54	51	41	35	15	4,253

N	50,157
Not employed, age 24	1,756
Age group exclusions: 20-24, 55 and over NA, degree	16,418
Total social scientists	68,331

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[a] PT&K = professional, technical, and kindred.

source of variation in educational attainment lies in the occupational origins of engineers: non-PT&K jobs at age twenty-four invariably resulted in lower levels of academic advancement in every age grade.

Scientists.--Among the four scientific and mathematical occupation groups, we find that, controlling for age, those who entered their 1960 occupation from other PT&K occupations were more likely to have completed the bachelor's program and to have entered graduate study (this was the case in eleven out of twelve comparisons). No differences were found in proportions completing the master's program by April, 1960, however. The familiar relationship vis-à-vis the doctorate prevailed, i.e., in every comparison, those holding jobs at age twenty-four in the same occupation as that in which employment was held in April, 1960, were more likely to complete the doctoral program. Thus, controlling for age, it is evident that the earlier speculation on the costs of switching occupations is supported by the data presented in this section. Furthermore, the lower levels of academic attainment noted with respect to those entering their 1960 occupations from jobs held in non-PT&K occupations at age twenty-four also held up when age grade was taken into consideration.

In general, the data suggest that differences in graduate level training and completion of graduate programs favoring the older age groups simply reflected differences in amount of time available for advanced study.

Summary

Chapter 2 has presented a profile of America's 1960 scientists and engineers, outlining selected characteristics in terms of the major variables employed in this report: occupation group by sex, by educational attainment, and by age group. The findings may be summarized as follows:

The sex composition of these five occupation groups varied from engineering (overwhelmingly male), and physical science (only slightly less male) to biological science (somewhat less), mathematics, and the social sciences, which show considerably more female representation.

The five occupation groups rank differently in terms of their respective age composition. Mathematicians proved the most youthful, followed by physical scientists, biological scientists, engineers, and finally social scientists.

At the time this survey was conducted, 93 per cent of the engineers down to 78 per cent of the mathematicians were married. Men and women in these occupation groups had substantially different marital profiles. Without exception, men were more frequently married than their female counterparts in each of the 1962 occupation groups. Likewise, women reported more separation, divorce, or widowhood. In general, men experienced more marital stability than women.

There were extensive differences among scientists and engineers in the extent to which incumbents of these occupational slots had attended college, received the baccalaureate, embarked upon graduate work, received the master's degree, and received the doctorate. Whether the first full-time civilian job secured at age twenty-four influenced the level of education achieved by 1960 was considered. Persons whose 1960 occupation group conformed to their occupation group at age twenty-four were compared with those who differed in their occupational affiliations at these two points in time, controlling for age, sex, and educational attainment. Workers holding jobs at age twenty-four in occupations below the PT&K level had lower levels of educational attainment by 1960 than their counterparts with jobs at age twenty-four in PT&K occupations.

CHAPTER 3

ELEMENTARY AND HIGH SCHOOL CHARACTERISTICS

Educational Origins: Types of Elementary and High Schools

Among the many public issues currently undergoing scrutiny by social scientists, there is one that is germane to our present investigation: the possible effects of education under varying organizational conditions on subsequent adult behavior as exemplified by career choice and types of employment actually secured. Since the Postcensal survey collected retrospective information on the types of elementary and high schools attended by persons in certain scientific, technical, and engineering occupations in April, 1960, it is possible to contribute (if only indirectly) to the current debate by documenting the extent to which engineering and scientific personnel with public, parochial, and private elementary and/or high school experience differ in their educational attainments. The questionnaire item in the survey that permits this kind of analysis went as follows:

> Which of the following types of elementary and high schools did you attend? (Check as many as apply.)
>
> Public
> Parochial
> Other private

Table 3.1 shows that between 90 and 95 per cent of the persons in these occupations in 1960 attended a public elementary or secondary school. Furthermore, at some time in their childhood or adolescence, or both, 12 to 14 per cent of these scientists and engineers attended a parochial school, with the exception of the biological scientists, whose attendance in this type of school was less frequent (8 per cent). Although information on religious affiliation was not secured in the Postcensal survey, it is reasonable to assume that all but a minor fraction of the parochial school attenders were in Catholic elementary or high schools. Representation of "other private" school students was more varied: social scientists were most likely to report this type of schooling (12 per cent) while the engineers and the biological scientists were least likely to have had early formal training under these conditions.

TABLE 3.1

TYPES OF ELEMENTARY AND HIGH SCHOOLS ATTENDED, BY OCCUPATION GROUP (1960)

(Per Cent)

Occupation Group (1960)	Type of Elementary or High School			Total[a]	Weighted Number of Persons
	Public	Parochial	Other Private		
Engineers	93	14	7	114	868,044
Physical scientists . . .	91	14	8	113	134,480
Biological scientists . . .	95	8	7	110	32,395
Mathematicians .	90	15	10	115	37,303
Social scientists	92	12	12	116	67,742

N	1,139,964
NA, type of school attended	14,543
Total N	1,154,507

[a] The rows add up to more than 100 per cent because of multiple responses to the question on type of schools.

Whether or not scientists or engineers were educated in these various types of elementary or high schools is a meaningful question only if an assessment is made of the possible consequences of exposure to one rather than another type of schooling. Were those who attended a parochial school as likely to enter graduate school or take the doctorate as respondents who reported public or private schooling? While the tabulations that are presently available do not allow us to sort out those who had mixed types of experience and contrast them with the scientists or engineers whose early education was solely public or solely parochial, it is still possible to compare those who had any of one type of exposure with others who had any of another type of early training.

Consider the educational attainments of these five occupation groups in Table 3.2,which shows the cumulative percentage distributions according to type of elementary or secondary school attendance. These comparisons show that scientists and engineers who attended a private elementary or high school were at an advantage in subsequent educational attainments in each of the occupational groups: engineering, physical science, life science, and mathematics. At the same time, experience at some time in childhood or adolescence in a parochial school, presumably Catholic in sponsorship, was systematically related to an underrepresentation in the physical, life, and social sciences and mathematics. Perhaps attendance at "other private" schools implies higher social class standing; perhaps it is indicative of superior ability or stronger curricular offerings. On the other hand, Catholic parochial schools, it is alleged, transmit values that deflect their students from the scientific and intellectual pursuits. However, there is some evidence that only recently a transformation has occurred in the products of Catholic education that should promote the disappearance of occupational differentiation with religious roots.

If this is the case, then it is crucial that school origins be examined from a time perspective. The best approximation of a trend study that is on hand is provided by the classification of these scientific and engineering personnel by age. If there has been a change in the character of parochial school education, then younger scientists who attended parochial elementary or secondary school should begin to approximate their

TABLE 3.2

EDUCATIONAL ATTAINMENT (1960), BY TYPES OF ELEMENTARY AND SECONDARY SCHOOLS ATTENDED AND OCCUPATION GROUP (1960)

(Percentage and Cumulative Percentage Distribution)

Occupation Group (1960)	Type of School	Per Cent					Cumulative Per Cent				Weighted Number of Persons[a]
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers . .	Public. .	46	30	17	6	1	53	23	7	1	784,442
	Parochial	47	27	20	5	1	53	26	6	1	113,295
	Private .	46	22	22	9	0	53	31	9	0	56,313
Physical scientists	Public. .	23	24	22	16	16	78	54	32	16	117,922
	Parochial	28	25	23	15	10	73	48	25	10	18,342
	Private .	19	17	23	19	22	81	64	41	22	10,162
Biological scientists	Public. .	17	16	16	23	29	84	68	52	29	29,490
	Parochial	24	17	22	26	11	76	59	37	11	2,630
	Private .	17	10	17	19	37	83	73	56	37	2,194
Mathematicians	Public. .	34	17	18	21	10	66	49	31	10	32,514
	Parochial	37	19	19	18	7	63	44	25	7	5,532
	Private .	27	12	22	25	14	63	51	39	14	3,528
Social scientists	Public. .	14	8	13	33	32	86	78	65	32	59,165
	Parochial	21	11	13	33	22	79	68	55	22	7,792
	Private .	16	7	13	33	31	84	77	64	31	7,646

N	1,107,168[a]
Degree exclusions	33,032
NA, type of school attended . . .	14,307
Total N	1,154,507

---

[a] N is smaller than the weighted number of persons because of multiple responses.

non-parochial peers in educational achievement. In the five panels of Table 3.3 each occupation group is broken into the three age groups: twenty-five to thirty-four; thirty-five to forty-four; forty-five to fifty-four.

Reviewing these findings, the evidence is overwhelming that (1) exposure to parochial schools at the elementary or high school level deflected the 1960 incumbents of scientific and engineering occupations from attaining advanced levels of academic proficiency to the same extent permitted by public school backgrounds; and (2) that there is little indication, if any, that the younger scientists and engineers with parochial school experience were more likely to catch up with their nonparochial fellows.

In his analysis of data in the NORC longitudinal study of career choice, Greeley (1963) showed that the June, 1961, baccalaureate recipients of American colleges of arts and sciences who were Catholic, and those who were Catholic and attended parochial high schools, were no different from Protestants in the extent to which they aspired to scientific careers. It is possible that the phenomenon that Greeley was documenting is so recent that an analysis of the Postcensal data that stops with scientists and engineers no younger than age twenty-five in 1960 would not catch this transformation of the outputs of parochial school systems. For this reason, let us consider the scientists in the age group twenty to twenty-four.

Table 3.4 shows that the pattern of academic attainment reflected in the cumulative distributions for the three older age groups no longer prevailed; events have taken a new turn and parochial school training among 1960 engineers and scientists in the age group twenty to twenty-four afforded no less an opportunity for advancement than did public elementary or high school background. The data even suggest that parochial school origins may be advantageous! When all three types of academic backgrounds are compared in each of the five occupation groups, then parochial school attenders did better than the others in extent of

TABLE 3.3

EDUCATIONAL ATTAINMENT (1960), BY TYPES OF ELEMENTARY AND SECONDARY SCHOOLS ATTENDED, AGE (1960), AND OCCUPATION GROUP (1960)

(Percentage and Cumulative Percentage Distributions)

a) Engineers

Type of School	Age (1960)	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Public	25-34	32	36	33	8	1	68	32	9	1	249,064
	35-44	44	31	17	7	1	56	25	8	1	266,534
	45-54	60	21	13	5	1	40	19	6	1	136,375
Parochial	25-34	36	34	23	7	0	64	30	7	0	42,569
	35-44	50	27	17	5	1	50	23	6	1	37,666
	45-54	65	17	13	5	0	35	18	5	0	16,118
Private	25-34	30	24	30	14	2	70	46	16	2	17,753
	35-44	45	23	21	11	0	55	32	11	0	15,350
	45-54	59	17	16	7	1	41	24	8	1	111,001

N[a] 699,632
Degree, age exclusions 174,168
NA, type of school attended . . . 5,942
Total engineers 879,742

---

[a] Sum of N's is greater than Total N because of multiple responses to type of schools.

TABLE 3.3--Continued

b) Physical Scientists

Type of School	Age (1960)	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Public	25-34	18	25	26	17	14	82	57	31	14	41,766
	35-44	18	24	21	17	20	82	58	37	20	38,890
	45-54	31	20	16	17	16	69	49	33	16	18,697
Parochial	25-34	22	25	25	18	10	78	53	28	10	7,497
	35-44	30	26	16	15	13	70	44	28	13	5,674
	45-54	40	16	20	16	8	60	44	24	8	1,971
Private	25-34	14	19	26	19	20	86	65	39	20	3,851
	35-44	15	18	19	16	32	85	67	48	32	2,922
	45-54	30	14	19	17	20	70	56	37	20	1,758

N[a]	110,224
Degree, age exclusions	24,853
NA	745
Total physical scientists .	135,822

---

[a] Sum of responses is greater than N because of multiple response to type of schools.

TABLE 3.3--Continued

c) Biological Scientists

Type of School	Age (1960)	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Public	25-34	10	19	20	28	23	90	71	51	23	8,832
	35-44	10	15	13	24	38	90	75	62	38	9,815
	45-54	19	14	12	23	32	81	67	55	32	5,053
Parochial	25-34	16	22	22	29	10	84	61	39	10	980
	35-44	16	9	18	40	15	84	73	55	15	681
	45-54	35	17	18	17	23	65	58	40	23	402
Private	25-34	15	15	24	19	27	85	70	46	27	639
	35-44	12	10	12	16	40	88	78	66	40	688
	45-54	21	7	15	18	39	79	72	57	39	404

N[a]	25,567
Degree, age exclusions	7,047
NA	265
Total biological scientists .	32,879

---

[a] Sum of responses is greater than N because of multiple response to type of schools.

TABLE 3.3--Continued

d) Mathematicians

Type of School	Age (1960)	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Public	25-34	20	22	26	24	8	80	58	32	8	10,436
	35-44	30	16	13	27	14	70	54	41	14	8,411
	45-54	38	14	13	19	16	62	48	35	16	5,614
Parochial	25-34	27	20	27	22	4	73	53	26	4	2,282
	35-44	33	16	9	29	13	67	51	42	13	1,344
	45-54	57	1	10	21	11	43	42	32	11	590
Private	25-34	23	12	26	22	17	77	65	39	17	1,292
	35-44	13	16	25	27	9	87	71	46	9	777
	45-54	36	7	10	31	16	64	57	47	16	571

N[a] 27,903
Degree, age exclusions 9,590
NA 240

Total mathematicians 37,733

[a] Sum of responses is greater than N because of multiple response to type of schools.

TABLE 3.3--Continued

e) Social Scientists

Type of School	Age (1960)	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Public	25-34	9	12	21	36	22	91	79	58	22	16,189
	35-44	10	7	8	36	39	90	83	75	39	18,923
	45-54	17	7	9	31	36	83	76	67	36	12,731
Parochial	25-34	14	11	21	40	14	86	75	54	14	2,506
	35-44	20	13	6	33	28	80	67	61	28	2,210
	45-54	15	4	10	35	36	85	81	71	36	1,205
Private	25-34	7	14	23	36	20	93	79	56	20	1,787
	35-44	9	2	6	38	45	91	89	83	45	2,037
	45-54	18	8	7	31	36	82	74	67	36	1,598

N[a]	52,468
Degree, age exclusions	15,672
NA	191
Total social scientists	68,331

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[a] Sum of responses is greater than N because of multiple response to type of schools.

TABLE 3.4

EDUCATIONAL ATTAINMENT (1960), BY TYPES OF ELEMENTARY AND HIGH SCHOOLS ATTENDED, AND OCCUPATION GROUP (1960)

(Age Group 20-24, 1960)

(Cumulative Percentage Distribution)

Occupation Group (1960) and Types of Elementary and Secondary Schools Attended	Cumulative Per Cent			Weighted Number of Persons
	Educational Attainment			
	Bachelor's	Bachelor's Plus	Master's	
Engineers				868,044
Private	66	49	7	
Public	51	23	1	
Parochial	72	39	2	
Physical scientists . . .				134,480
Private	58	44	5	
Public	64	33	3	
Parochial	73	39	4	
Biological scientists . .				32,395
Private	74	54	6	
Public	60	37	6	
Parochial	67	45	1	
Mathematicians				37,303
Private	74	38	0	
Public	54	35	5	
Parochial	66	28	0	
Social scientists				67,742
Private	53	48	26	
Public	65	51	13	
Parochial	62	37	13	

N	1,139,964
NA	10,679
Degree exclusions	3,864
Total N	1,154,507

academic attainment at the bachelor's level. Private school attenders maintained their lead in terms of entry to graduate school and completion of the master's degree. Of course, it is too soon for this age group to have completed the doctorate save for the outstanding exceptional individual.

Comparisons between the parochial and public school engineers and scientists show a striking change from the almost perfect correlation between type of early academic background and rank order on extent of academic attainment prevailing in the three older age groups. Specifically, in four out of five occupation groups (social science was the exception), parochial school attenders were more likely to have completed the bachelor's program. At the next level (entry into graduate school), those with parochial school backgrounds in the three occupation groups of engineering, physical science, and biological science outranked their public school fellows; while at the next level (completion of the master's degree), public and parochial attenders each reported a higher rate of completion in two occupation groups and a tie in the other.

It is clear that only in the past few years a striking change has occurred in the influence on levels of subsequent educational attainment of parochial school attenders at the elementary and high school level. In this section of the report, let it suffice to document this change. At a later state in the analysis of these data, this newly emergent relationship may be studied in greater depth.

Educational Origins: Types of High School Curricula

Another item of information included in the Postcensal survey concerns the type of high school curriculum that was offered to the 1960 scientist and engineer in his senior year. Just as the question was posed in the previous section on the relationship between types of elementary and high schools attended and subsequent educational attainment, we may ask whether workers in the experienced civilian labor force in selected occupations were differentiated on the basis of curriculum studied during the last year of high school. The survey item was:

> During your senior year in high school,
> was your curriculum--(Check one.)
>
> Academic
> General
> Technical
> Vocational
> Commerical
> Other
> Did not attend through
> senior year

Differences by type of senior year high school curriculum offering are shown in Table 3.5. Close to eight out of ten 1960 social scientists (77 per cent) reported "academic" types of curricula in their senior year as did two-thirds of the mathematicians (68 per cent), almost as many biological scientists (64 per cent), and over six out of ten physical scientists (61 per cent). In contrast, fewer than one-half (43 per cent) of the engineers reported this type of curriculum in their last year of high school. Engineers were "different" from scientists in the extent to which the 1960 incumbents were likely to take academic types of courses of study that presumably are prerequisites of entry to college. On the other hand, one out of four engineers reported a "general" curriculum; among physical scientists, some 22 per cent reported "general" curriculum study as did 25 per cent of the biological scientists. Even fewer mathematicians (16 per cent) and social scientists (14 per cent) were in this type of program in the last year of high school. Another occupational pattern appeared in relation to "technical" curricular offerings: fully 21 per cent of the engineers as contrasted with 2 per cent of the social scientists were in this type of high school program, the remaining occupations falling in the middle. In effect, the percentage reporting "technical" curricular work in their senior year in high school varied inversely in rank order with the percentage indicating "academic" work in these five occupation groups.

Whether or not a high school student graduated via the "academic" route says much about his prospects for further study. The three panels

TABLE 3.5

TYPE OF CURRICULUM, SENIOR YEAR IN HIGH SCHOOL, BY OCCUPATION GROUP (1960)

(Per Cent in Each Type of Curriculum)

Occupation Group (1960)	Academic	General	Technical	Vocational	Commercial	Other	Did Not Graduate from High School	Total	Weighted Number of Persons Who Went to High Schools
Engineers . . .	43	25	21	3	3	2	3	100	832,002
Physical scientists .	61	22	11	1	1	2	2	100	131,116
Biological scientists .	64	25	4	3	2	1	2	101	31,575
Mathematicians	68	16	4	1	6	1	3	99	36,814
Social scientists .	77	14	2	1	3	1	1	99	66,502

N	1,097,379
N, high school . . .	26,820
NA, type of curriculum	30,308
Total N	1,154,507

of Table 3.6 show the percentage of each occupation group at each level of educational attainment who had senior high school work that was academic, general, and technical. Two conclusions appear from these data:

> First, academic course work at the high school level is the key that opens the door to higher education. Scientists and engineers who held the bachelor's as their highest degree, entered graduate school, and took the master's or held the doctorate in 1960 were concentrated among those who reported academic course work in senior year in high school; and
>
> Second, despite the importance of academic preparation at the high school level, considerable slippage occurred permitting advanced training more readily in some fields than in others even when nonacademic preparation was taken.

Academic curricular backgrounds.--The first panel shows that with each step up the academic ladder, the proportion reporting academic high school preparation in the senior year increased. For example, engineers who held no academic degree in 1960 were in this type of high school curriculum in only three cases out of ten, while eight out of ten (78 per cent) of the engineers who hold doctorates reported this type of preparation. Similarly, 54 per cent of the social scientists who were lacking a four-year degree were "academic" while 87 per cent of the incumbents of social science positions in the experienced civilian labor force in 1960 who were recipients of the doctorate were "academic" in high school backgrounds. It is noteworthy, as well, that the amount of variation among the five occupation groups in the proportion reporting academic backgrounds steadily narrowed with each step forward. Among the bachelor's recipients, twenty-four percentage points separated the bottom (engineers) from the top occupation group (mathematicians); at the doctoral level, the spread in percentage points was reduced to thirteen. Academic preparation at the high school level evidently was of almost equal importance in every occupation group at the doctoral level, but greater variation was possible earlier in the academic game.

TABLE 3.6

TYPE OF CURRICULUM IN SENIOR YEAR IN HIGH SCHOOL BY EDUCATIONAL ATTAINMENT, 1960, AND OCCUPATION GROUP, 1960

(Per Cent in Each Type of Curriculum)

Occupation Group (1960)	Academic					General				
	Educational Attainment					Educational Attainment				
	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Engineers. . .	30	48	55	65	78	30	23	19	15	12
Physical scientists .	41	56	67	72	81	33	25	16	18	11
Biological scientists .	44	59	67	64	75	32	28	24	26	19
Mathematicians	45	72	76	81	91	26	14	14	11	7
Social scientists .	54	68	76	80	87	24	23	15	13	19
	Technical					Weighted Number of Persons				
	Educational Attainment					Educational Attainment				
	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Engineers . .	22	22	21	15	9	353,395	246,288	148,674	53,179	7,569
Physical scientists .	12	14	12	7	5	28,218	30,204	28,029	20,472	20,170
Biological scientists .	4	5	4	4	2	4,611	4,830	4,915	7,162	8,795
Mathematicians	4	6	4	4	1	11,193	6,166	6,455	7,567	3,589
Social scientists .	4	2	2	1	1	8,414	5,601	8,149	21,355	19,885

N	1,064,885
Degree exclusions	32,494
NA, type of curriculum	30,308
No high school	26,820
Total N	1,154,507

General curricular backgrounds.--From one-quarter to one-third of the incumbents of these five occupation groups reported "general" high school preparation if they held no academic degree in 1960. The proportion undertaking this type of high school preparation in their senior year typically declined with each academic level. For example, some 25 per cent of the physical scientists holding the bachelor's as their highest degree were in "general" course work in high school as compared with 11 per cent who held the doctorate in 1960. From the baccalaureate through to the doctorate, the biological scientists were most likely of all scientists or engineers to report this type of high school background while the social scientist were least likely to do so. Whether 1960 incumbents attended high schools that differed in the range of course offerings cannot be determined directly from these data. However, as shown below, biological scientists differed from the remaining occupation groups in the size of their high school graduating class (see Table 3.7). Whether size of graduating classes was related to types of curricular offerings also must be deferred for later analysis.

Technical backgrounds.--If 1960 scientists and engineers at advanced levels of educational attainment were unlikely to have reported general preparation in high school in contrast to academic preparation, then the third panel of Table 3.7 shows that they were even less likely to have "technical" curricular backgrounds in the senior year of high school. Furthermore, even when technical backgrounds were reported, they declined in frequency with each academic step forward. More importantly, while the percentage of biological scientists, mathematicians, and social scientists reporting this form of high school preparation were negligible, there was substantial representation of this form of high school training among the engineers and to a lesser extent among the physical scientists. Over one out of five engineers who held no degree received technical training in their senior year; the same proportion reported this form of high school preparation among the bachelor's recipients and among the

TABLE 3.7

EDUCATIONAL ATTAINMENT (1960), BY TYPE OF SENIOR HIGH SCHOOL CURRICULUM AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers	68	35	11	2	354,066	47	18	4	0	201,470	54	23	5	0	173,430
Physical scientists	85	63	40	21	78,247	65	38	21	8	27,772	74	43	18	8	13,814
Biological scientists	89	75	58	34	19,458	80	62	46	22	7,567	82	59	43	19	1,084
Mathematicians	77	59	38	13	23,863	49	34	19	4	5,833	67	41	24	2	1,461
Social scientists	90	83	70	35	49,187	77	63	50	19	9,051	62	53	33	15	1,039

N	967,342
Degree exclusions	130,037
NA, type of curriculum	30,308
No high school	26,820
Total N	1,154,507

entrants to graduate school as well. However, at the doctoral level the percentage declined to 9.

The data presented thus far on types of high school curricula illuminate another aspect of the academic origins of 1960 engineers and scientists. When these same data are presented as cumulative percentage distributions for each of the five occupation groups, they point to the crucial role of the high school academic curriculum in determining the subsequent chances for educational advancement by those employed in 1960 in the sciences and engineering.

Table 3.8*a*-*e* gives cumulative percentage distributions for each age group in order to ascertain whether various types of high school preparation had a different impact on subsequent academic performance and whether the differences in favor of academic preparation varied by age group.

Considering first the question of rank order of proportions indicating any given level of educational achievement within each occupation group in the four age groups, the weight of the evidence was overwhelmingly in favor of academic course work in the senior year of high school. In seventy-five possible comparisons (there were no doctorate holders to speak of in the age group twenty to twenty-four) scientists and engineers with academic backgrounds in their senior year of high school ranked first in rates of completion in some sixty-seven comparisons. For example, in virtually every comparison between academic, general, and technical high school backgrounds, in each of the four age groups physical scientists with academic preparation outdistanced their counterparts whose senior year curriculum happened to be "general" or "technical" in proportions completing the bachelor's degree. Chances of entering graduate school or taking the master's degree and the doctorate, were more favorable if there were an academic curriculum than if other types of preparation were reported, etc. This was true of each of the five occupation groups. Technical as compared with general preparation in the senior year of high school conferred no special benefit: both lagged well behind the academic

TABLE 3.8

EDUCATIONAL ATTAINMENT (1960), BY TYPE OF SENIOR HIGH SCHOOL CURRICULUM BY AGE (1960), AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

a) Engineers

Age Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons
	Educational Attainment					Educational Attainment					Educational Attainment				
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
20-24	64	33	2	0	23,515	36	21	1	0	7,827	55	20	1	0	11,111
25-34	76	40	12	1	133,174	58	22	5	1	59,369	67	29	7	0	52,601
35-44	68	33	12	2	123,625	49	19	5	0	69,829	54	24	5	1	55,905
45-54	54	29	11	2	49,548	35	14	4	0	38,476	42	19	5	0	31,203

N	656,183
Degree exclusions	150,752
NA, type of curriculum	25,067
No high school	47,740
Total N	879,742

TABLE 3.3--Continued

b) Physical Scientists

Age Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons
	Educational Attainment					Educational Attainment					Educational Attainment				
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
20-24 . .	69	41	4	1	6,717	57	19	2	0	1,920	60	31	5	0	1,266
25-34 . .	85	63	37	18	30,748	64	37	19	6	9,699	80	45	17	4	5,122
35-44 . .	88	67	46	27	25,569	71	42	25	9	9,264	78	49	21	9	4,150
45-54 . .	81	62	44	23	10,989	59	36	21	9	4,603	64	39	22	14	2,245

N	112,292
Degree exclusions	18,824
NA type of curriculum	2,674
No high school	2,032
Total N	135,822

TABLE 3.8--Continued

c) Biological Scientists

Age Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
20-24 . .	73	44	8	1	1,852	37	24	0	0	469	0	0	0	0	18
25-34 . .	92	76	56	27	5,869	87	64	46	18	2,471	91	66	44	17	365
35-44 . .	94	81	68	43	6,442	87	68	55	28	2,457	89	71	52	33	332
45-54 . .	89	79	65	42	3,351	78	61	47	21	1,251	81	50	35	5	212

N	25,089
Degree exclusions	6,486
NA type of curriculum	599
No high school	705
Total N	32,879

TABLE 3.8--Continued

d) Mathematicians

Age Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons	Cumulative Per Cent Educational Attainment				Weighted Number of Persons
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
20-24 . .	62	35	4	0	3,371	34	20	2	0	509	64	41	5	0	196
25-34 . .	86	66	33	10	8,249	64	46	19	0	1,856	63	32	16	0	643
35-44 . .	81	67	51	18	6,264	46	35	25	7	1,584	67	58	43	4	306
45-54 . .	78	63	48	23	3,667	44	28	23	7	1,180	80	46	27	0	166

N	27,991
Degree exclusions	8,193
NA type of curriculum	893
No high school	656
Total N	37,733

TABLE 3.8--Continued

e) Social Scientists

Age Group (1960)	Type of Senior High School Curriculum														
	Academic					General					Technical				
	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons	Cumulative Per Cent				Weighted Number of Persons
	Educational Attainment					Educational Attainment					Educational Attainment				
	Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate		Bachelor's	Bachelor's Plus	Master's	Doctorate	
20-24 . .	64	51	18	0	2,243	54		8	0	476	100	0	0	0	40
25-34 . .	93	83	64	25	13,601	82	63	39	8	2,518	69	56	39	26	347
35-44 . .	94	88	80	43	15,944	82	70	64	24	2,730	65	57	27	10	300
45-54 . .	89	82	72	42	9,957	77	68	61	28	1,881	63	50	46	17	221

N	50,258
Degree exclusions	16,244
NA type of curriculum	1,075
No high school	754
Total N	68,331

groups, and there was no stable pattern across the five occupation groups that distinguished the effects of one rather than the other type of curriculum.

As was the case in assessing public and parochial backgrounds among the age groups, here too there were no historical differences in the relationship between high school curricula and subsequent academic accomplishment. In each of the three major age groups (twenty-five to thirty-four, thirty-five to forty-four, and forty-five to fifty-four) there was little that differentiated technical from general high school backgrounds, but both groups were outperformed by those with academic preparation.

There was one important development among the scientists and engineers in the age group twenty to twenty-four. While the academic group maintained its lead, the gap between this group and the other two was not as great as that found among the older age groups. In each of the three occupation groups of engineering, physical sciences, and biological sciences, the group with technical or general preparation took the lead in rates of completion. And among mathematicians, students with "technical" preparation maintained a lead over the academic group in each of three comparisons. It was only among the social scientists that the usual pattern was found.

Perhaps one interpretation of this changing pattern among the youngest scientists and engineers is that these 1960 incumbents of these occupations benefited from post-Sputnik efforts to stengthen the high school curriculum in mathematics and the sciences. It is conceivable that the noticeable change in academic performance reflects this national concern.

Educational Background: Size of High School Graduating Class

The proposition that the elementary or high school system which scientists and engineers passed through on their way to their 1960 employment influenced their subsequent educational accomplishments has been shown to be valid for certain age groups, but not for others. This study also shows that the types of curricula in the senior year of high school, whether deliberately selected or taken because alternative courses of study were not available at that particular high school, serve as a mechanism that screens out or deflects some students and systematically facilitates the academic progress of others. Now we wish to examine a third aspect of high school education and trace its possible effects on the later academic attainments of these scientists and engineers: Did the size of the high school graduating class affect the 1960 academic achievement level of these professional workers?

Size of graduating class presumably correlates with size of high school; and large high schools should be more varied in their course offerings and allow for the development of specialized scientific interests more readily than small high schools. Furthermore, this variable is known to correlate with career choice (Harmon, 1961, p. 688). However, inspection of Table 3.9 shows that with one exception, the classification of these 1960 incumbents by size of graduating class in high school yielded negligible differences. The exception occurred among biological scientists: they were disproportionately recruited from small graduating classes, especially those of less than fifty, and the same occupation group was underrepresented among the largest graduating classes. In fact, they showed the lowest rate of representation in each of the five detailed size groups starting at 100-199 and ranging up through the graduating class of 500 or more. This deviant pattern of recruitment reflects the predominantly rural origins of the agricultural scientists included in this occupation group; also, other biological scientists raised in small towns or villages that lacked the population base for a high school organized to serve larger numbers of students would account for this finding.

Even this one source of variation is a negligible factor if we ask: "Did scientists and engineers in these five occupation groups differ in their academic origins as measured by size of high school graduating

TABLE 3.9

SIZE OF HIGH SCHOOL GRADUATING CLASS, BY OCCUPATION GROUP (1960)

(Per Cent in Each Size Group)

Occupation Group (1960)	50 or Less	50-99	100-199	200-299	300-399	400-499	500 or More	Did Not Graduate	Total	Total Persons Who Attended through Senior Year
Engineers . .	23	16	20	15	10	6	10	1	101	801,806
Physical scientists .	26	18	20	13	8	6	9	0	100	128,120
Biological scientists .	36	19	18	11	6	5	7	0	102	30,936
Mathematicians	25	15	20	14	9	7	11	1	102	35,147
Social scientists .	28	16	19	12	8	5	11	0	99	65,312

N	1,061,321
Did not graduate	58,405
NA for size of high school graduating class	34,781
Total N	1,154,507

class if they are classified by their highest academic degree in 1960?" Table 3.10 shows that there was a small but persistent difference in the proportion graduating with a large class, i.e., three hundred or more, in favor of those who entered graduate school, held the master's as the highest degree, or held the doctorate as the highest degree in the three occupation groups of engineering, physical science, and social science. Among the biological scientists, there were no differences in the percentage from large graduating high school classes and among the mathematicians, the size relationship was reversed, with slightly fewer recipients of advanced graduate degrees stemming from large graduating classes.

Certain organizational conditions under which elementary or high school training was secured proved to be a factor in the later academic performance of 1960 engineers and scientists. Also, types of curricula importantly influenced who would go on for advanced training and who would successfully secure advanced degrees by 1960 if such training were initiated, but size of high school graduating class had little influence on subsequent educational attainment of workers in these five occupational groups.

Summary

The great majority of scientists and engineers attended public school. Biological scientists were least likely to have attended parochial school, while social scientists and mathematicians were more likely than others to have attended private school. Academic attainment was associated with the different types of elementary and high school attendance: of those who had attended private school, the greatest percentage went on for higher degrees. Those who had attended public and parochial schools ranked second and third respectively in the percentage that obtained higher degrees. This pattern held when age groups twenty-five to thirty-four, thirty-five to forty-four, and forty-five to fifty-four were examined. However, the academic performance of the twenty to twenty-four age group

TABLE 3.10

EDUCATIONAL ATTAINMENT (1960), BY SIZE OF HIGH SCHOOL GRADUATING CLASS AND OCCUPATION GROUP (1960)

(Percentage and Cumulative Percentage Distribution)

Occupation Group (1960)	Size of Graduating Class	Per Cent					Cumulative Per Cent				Weighted Number of Persons
		Educational Attainment					Educational Attainment				
		No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers	Less than 100 . . .	45	31	17	6	1	55	24	7	1	311,962
	100-299 . .	42	31	19	7	1	58	27	8	1	278,487
	300 or more	39	31	22	7	1	61	30	8	1	195,657
Physical scientists	Less than 100 . . .	23	25	19	17	16	77	52	33	16	55,017
	100-299 . .	20	28	24	14	15	80	53	29	15	41,101
	300 or more	20	18	25	20	17	80	62	37	17	28,319
Biological scientists	Less than 100 . . .	14	16	15	26	29	86	70	55	29	16,325
	100-299 . .	16	17	18	21	28	84	67	45	28	8,248
	300 or more	15	16	18	22	29	85	69	51	29	5,203
Mathematicians	Less than 100 . . .	29	17	16	25	13	71	54	38	13	13,749
	100-299 . .	33	18	21	19	9	67	49	28	9	11,397
	300 or more	34	18	20	19	9	66	48	28	9	8,939
Social scientists	Less than 100 . . .	14	10	12	32	32	86	76	64	32	27,603
	100-299 . .	13	9	13	37	28	87	78	65	28	19,581
	300 or more	13	6	14	33	34	87	81	67	34	15,021

N	1,036,600
Degree exclusions	24,721
NA for size, high school graduating class	34,781
Did not complete high school . .	58,405
Total N	1,154,507

suggested that differences in public and parochial school ranking in education are disappearing.

Significant differences were found between the occupation groups with regard to the type of senior year high school curriculum that was pursued. An academic curriculum was reported by 77 per cent of the social scientists, 68 per cent of the mathematicians, 64 per cent of the biological scientists, 61 per cent of the physical scientists, and 43 per cent of the engineers. Proportionately more engineers reported general and technical curricula than social scientists, while the other occupation groups ranked between them.

The senior year high school curriculum was related to academic attainment regardless of occupation group. In two instances, engineering and physical sciences, approximately half again as many more Ph.D's as B.A.'s had taken an "academic curriculum," while half as many Ph.D.'s as B.A.'s had taken a general curriculum. An even greater dropoff occurred among those with technical backgrounds.

With one exception, the differences among the five occupation groups in the distribution of those employed in those groups in 1960 by size of high school graduating class yielded negligible differences. Apparently size of high school graduating class and its correlate, organization size, had little influence on the subsequent educational attainment behavior of workers in these occupations.

CHAPTER 4

FIELDS OF STUDY FOR DEGREES HELD IN 1960 AND 1962

Academic Origins: Field of Study for Highest Degree Secured

It is one of the facts of academic life that increasingly early specialization and mastery of delimited areas of knowledge are necessary if a student is to forge ahead in the sciences. A variety of studies on career choice have shown that the opportunity for switching fields is one-sided. For example, while it is possible for a college junior majoring in physics to shift into certain of the social science fields without serious loss of time, the reverse is not true: the social science major switching to physical science fields of study probably would suffer substantial delay in completing an undergraduate program, and it is questionable whether there was sufficient formal training accumulated to permit him to retool. A recent study of graduate students in the sciences and engineering showed that as they moved from the bachelor's level through the master's and on to the doctorate, there occurred ever increasing concentrations of students in that field of specialization (Warkov, 1964). Was this also the case among scientists and engineers in the experienced civilian labor force in 1960? To what extent was the field of specialization for the highest degree attained in 1960 similar to the occupation group in which they were employed at the time the Bureau of the Census conducted the 1960 Census of Population?[1]

Ignoring for the moment the level of the highest degree held, Table 4.1 shows that the great majority of the workers in these occupations held degrees in fields of specialized study that coincided with the occupational classification employed in this study. There was also substantial variation in the extent of concentration, ranging from a high of 83 per cent of the engineers holding their highest academic degree in this field to 56 per cent of the mathematicians holding an academic degree coinciding with their 1960 occupation.

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[1] The reader will note a section of tables in Appendix 3, identical in design to those included along with the text, but taken from 1962 materials. It had been expected that there would be some important and interesting differences between the 1960 and 1962 findings, but, as comparison of the corresponding tables will reveal, there are no such differences

Findings presented on field of specialized study for the highest academic degree held by 1960 among incumbents of the five occupation groups testify to the slippage that occurred in each field, but it is only a first approximation of the picture that is developed in this section. To properly describe the links between the training scientists and engineers receive and their subsequent employment, let us re-examine these data (Table 4.2) specifying the extent of concentration for each degree level.

Engineers.--Concentration in engineering was increasingly diluted with each step up the academic ladder while degrees in the physical sciences became increasingly prevalent among the 1960 engineers. Some 87 per cent of those whose highest degree was the bachelor's had studied in engineering fields while doctorate holders in only sixty-five cases out of one hundred secured this degree in engineering. Conversely, 5 per cent of the bachelor's degree holders in this occupation group were physical science majors, but this was the case for 20 per cent of the engineers with doctorates.

Physical scientists.--The opposite pattern obtained in this occupation group. Recipients of the doctorate were more frequently trained in the physical sciences (90 per cent) than were those holding the bachelor's as their highest degree in 1960 (76 per cent). Engineering backgrounds become increasingly rare at each successively higher degree level: some 11 per cent of the holders of the baccalaureate in this occupation group held an engineering degree; only 2 per cent of the holders of the doctorate were in engineering.

Biological scientists.--While the doctorate was most frequently secured in biological science fields of study (89 per cent), there was no degree-related pattern below this level. The more important source of variation occurred within the occupation group. The proportion of degrees secured

TABLE 4.1

FIELD OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE (1960), BY OCCUPATION GROUP (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Teaching		Education (Other)	Engineering	Mathematics and Statistics	Physics	Chemistry	Other Physical Science	Total Physical Science	Biology	Agriculture	Total Biological Science	Health	Psychology	Social Science (Other)	Total Social Science	Humanities	Technical Specialties	Other	Weighted Number of Persons
	Elementary School	Secondary School																		
Engineers.	0	1	1	83	1	2	2	1	5	0	1	1	1	0	2	2	1	0	4	446,428
Physical scientists.	0	2	2	8	2	12	49	16	77	3	1	4	2	0	1	1	1	0	1	93,850
Physical scientists.	0	2	2	1	0	0	4	1	5	55	26	81	4	1	2	3	1	0	1	24,340
Mathematicians . . .	1	5	5	4	56	3	2	1	6	1	1	12	0	2	8	10	3	0	10	22,137
Social scientists. .	1	2	8	2	1	0	1	0	1	1	2	3	1	24	33	57	3	0	21	50,312

N	637,067
NA, other	49,880
No degree	467,560
Total N.	1,154,507

TABLE 4.2

FIELD OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE (1960), BY EDUCATIONAL ATTAINMENT (1960) AND OCCUPATION GROUP, (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Educational Attainment	Teaching		Education (Other)	Engineering	Mathematics and Statistics	Physics	Chemistry	Other Physical Science	Total Physical Science	Biology	Agriculture	Total Biological Science	Health	Psychology	Social Science (Other)	Total Social Science	Humanities	Technical Specialties	Other	Weighted Number of Persons
		Elementary School	Secondary School																		
Engineers	Bachelor's	0	1	1	87	1	2	2	1	5	0	1	1	0	0	1	1	0	0	3	237,097
	Bachelor's Plus	0	1	1	80	2	3	3	1	7	0	0	0	1	0	2	2	1	0	5	141,207
	Master's	1	2	2	74	3	3	3	2	8	0	1	1	1	1	1	2	1	0	6	49,873
	Doctorate	0	0	3	65	2	8	7	5	20	0	0	0	1	1	1	2	1	1	5	7,040
Physical scientists	Bachelor's	0	1	2	11	2	5	54	17	76	3	1	4	1	0	1	1	1	0	2	28,128
	Bachelor Plus	1	2	1	10	3	11	45	14	60	4	2	6	3	0	1	1	2	0	2	26,865
	Master's	0	3	3	7	2	15	38	24	77	3	1	4	1	0	1	1	1	0	2	18,928
	Doctorate	0	0	1	2	0	22	57	11	90	4	1	5	1	0	1	1	1	0	0	19,045
Biological scientists	Bachelor's	0	2	1	2	0	0	4	1	5	39	41	80	5	1	3	4	0	0	2	4,561
	Bachelor's Plus	1	3	2	2	1	1	7	1	9	43	26	69	8	1	2	3	2	0	2	4,631
	Master's	1	3	3	2	0	0	3	0	3	51	31	82	1	2	3	5	1	0	0	6,696
	Doctorate	0	0	2	1	0	0	4	0	4	77	12	89	1	1	1	2	0	0	1	8,092
Mathe-maticians	Bachelor's	1	6	1	4	51	1	3	1	5	1	3	4	0	1	10	11	2	0	17	5,679
	Bacheler's Plus	1	5	2	6	50	4	4	1	9	1	1	2	1	2	8	10	5	0	10	5,967
	Master's	0	4	9	3	60	2	1	1	4	1	1	2	0	1	9	10	2	0	5	6,947
	Doctorate	0	3	5	1	71	4	2	0	6	2	1	3	0	2	6	8	2	0	2	3,250
Social scientists	Bachelor's	1	5	2	9	3	0	1	0	1	0	4	4	1	5	25	30	6	0	39	4,910
	Bachelor's Plus	1	2	3	6	2	0	1	0	1	1	2	3	1	16	29	45	7	0	28	7,636
	Master's	2	2	10	0	0	1	1	2	4	2	1	3	0	23	27	50	2	0	26	19,321
	Doctorate	0	1	9	0	1	0	1	0	1	1	1	2	0	33	43	76	2	0	7	18,115

N	623,988
NA, other	47,317
Degree exclusions . . .	483,202
Total N	1,154,507

in the agricultural sciences decreased, the higher the degree level, while the degrees taken in the "pure" biological sciences increased. Specifically, almost equal proportions held the bachelor's degree (about four out of ten) but at the doctoral level this percentage dropped to 12 for agricultural science fields of study and climbed to 77 for biological science fields.

Mathematicians.--Here, too, the proportion taking a degree in the fields of mathematics or statistics increased with each academic step upward. About one-half (51 per cent) of the bachelor recipients secured this highest degree in a field coinciding with their 1960 occupation; at the doctoral level, seven out of ten (71 per cent) did likewise. It is evident that the formal requirements become increasingly stringent at the upper reaches. At the bachelor's level, 17 per cent studied in unspecified "other" fields while 2 per cent at the doctoral level were in "other" fields of study for this degree.

Social scientists.--The pattern noted among mathematicians was accentuated among incumbents of this occupation group. Again, the proportions taking degrees at each level were more likely to be in social science specialized fields of study at the doctoral level than at the bachelor's: 76 per cent at the top and only 30 per cent holding the bachelor's were trained in social science fields. Apparently 1960 employment qua "social scientist" was wide open. More persons held "other" degrees at the bachelor's level (39 per cent) than held social science degrees. At the doctoral level this avenue to social science employment was almost shut off, the percentage with "other" fields of study here being reduced to 7.

Having described the field origins of scientists and engineers, we turn to the related question of the relative advantages for subsequent educational advancement of taking their highest academic degree by 1960 in a field of specialized study that coincided with their 1960 occupation group, as compared with taking this degree in a field that was not identical with the 1960 occupation group. The comparisons that are shown in the five panels of Table 4.3 shed light on the costs of having less than a perfect match between field of study and field of employment (assuming that the 1960 occupation group classification does indicate field of employment). In each of the occupation groups except engineering, persons holding their highest academic degree in 1960 in their field of employment were more likely to have attained higher levels of academic training than their fellows in other fields of study.

Occupation Group, Educational Attainment, Field of Study, and Sex

Since there are substantial differences among the four science occupation groups in their female representation, we will, in the pages that follow, determine whether men and women in these scientific occupations differ in the extent to which their field of employment as indicated by the 1960 occupation coincide with the specialized field of study for the highest degree held in 1960. In doing so, we will consider the congruence between field of study and field of employment as a problem linked to sex differentiation in occupational roles.

Two questions will be considered: Did men and women show the same level of correspondence between 1960 occupation groups and the specialized field of study for the highest degree held in 1960? Did sex roles intervene to alter the relationship originally observed of increasing correspondence between field of employment and field of study with each step upward in academic degree secured by these 1960 scientists?

To answer the first question, the data are summarized in Table 4.4a, which shows the percentage in each occupation group holding their highest degrees in "other" fields, taking into account sex and educational level. While it is evident that level of educational attainment was still the primary correlate of congruence between field of study and field of employment, there were sex differences that tended to confound this relationship in certain fields but not in others. For example, at the doctoral level, proportionately fewer men than women held degrees in "other" fields than in their field of occupational affiliation. If we maintain this "same-other" distinction among fields at the level of classification given by the occupation

TABLE 4.3

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED BY 1960 OF WORKERS IN FIVE OCCUPATION GROUPS (1960), BY FIELD OF STUDY

(Cumulative Percentage Distribution)

Occupation Group (1960)	Selected Fields of Specialized Study	Cumulative Per Cent Educational Attainment			Weighted Number of Persons
		Bachelor's Plus	Master's	Doctorate	
Engineers	Engineering	42	11	1	368,981
	Other	56	20	3	77,246
Physical scientists	Engineering	58	22	4	7,610
	Physics	87	61	37	11,572
	Chemistry	66	40	24	45,578
	Other physical science	69	44	14	15,010
	Other	69	33	11	14,239
Biological scientists	Biological science.	87	72	47	13,438
	Agricultural science	69	50	16	6,220
	Other	79	48	23	4,705
Mathematicians	Mathematics and statistics. . . .	76	52	18	12,467
	Social sciences . .	70	45	10	1,832
	Other	69	37	10	7,829
Social scientists	Education	97	91	40	3,927
	Psychology.	98	87	50	11,978
	Social sciences (other)	93	79	47	16,488
	Other	80	58	15	17,786

N	636,906
NA	19,110
Degree exclusions. . . .	498,491
Total N.	1,154,507

TABLE 4.4

OCCUPATION GROUP (1960), EDUCATIONAL ATTAINMENT (1960), AND SEX

(Percentage Distribution)

a) Per Cent Whose Field of Study for Highest Academic Degree Differed from 1960 Occupation Group

Occupation Group (1960)	Educational Attainment (1960)							
	Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women
Physical scientists . . .	26	13	30	19	24	16	10	14
Biological scientists . .	16	31	27	50	16	29	11	11
Mathematicians	51	45	50	52	38	48	29	36
Social scientists	72	67	56	51	44	62	23	26

b) Per Cent Whose Field of Study for Highest Academic Degree was the Same as 1960 Occupation Group

Field of Specialized Study								
Physical scientists								
Chemistry	51	79	43	76	36	63	57	62
Other physical science .	23	8	27	5	40	21	33	24
Biological scientists								
Biology	29	69	41	50	48	70	76	89
Agriculture	55	0	32	0	36	1	13	0
Mathematicians								
Mathematicians	49	55	50	48	62	52	71	64
Social scientists								
Psychology	3	8	16	17	23	23	31	46
Other social science . .	25	25	28	32	33	15	46	28

c) Weighted Number of Persons

Physical scientists . . .	25,774	2,354	24,823	2,042	17,831	1,097	18,411	634
Biological scientists . .	3,447	1,114	3,798	833	5,804	892	1,564	528
Mathematicians	3,779	1,900	4,948	1,019	5,712	1,235	300	250
Social scientists	3,255	1,655	6,174	1,462	13,379	5,942	15,467	2,648

N	186,071
NA	9,829
Degree exclusions	78,865
Total scientists . . .	274,765

groups, then sex differences in rates of recruitment to their 1960 occupation from other fields of study depended heavily on educational level. At the bachelor's level, men were more frequently employed in their occupation group with the degree secured in "other" fields of study; at the doctoral level, the reverse held true, although the differences were neither great nor fully consistent. The latter finding should be treated with caution since it was also the case that the "same-other" distinction at the occupation group level obscured the very pronounced intra-occupation group variation in the extent to which men and women concentrated their employment in their field of study at each degree level. This is shown in Table 4.4b.

In sum, a fairly complicated pattern obtained across the four scientific occupation groups with respect to academic origins as represented by the field of specialized study for the highest degree held in 1960. There was much variation that apparently has to do with sex differentiation, but it is impossible at this time to pinpoint with the data at hand exactly how these differences arise. There is good reason to expect that measures of life cycle and family role will be useful in elaborating these relationships.

It is evident that correlation between field of study and field of employment differed according to occupation group as well as sex: congruence increased with each successively higher level of academic attainment; and this congruence was more evident among men than among women at the lower academic levels while the reverse was true in the upper reaches.

Once again we consider the possible consequences for educational attainment of securing a degree in fields of study outside the occupation group of employment. Here we ask whether sex roles modified the earlier finding that fields of study for the highest degree not coinciding with the occupational affiliation yielded lower levels of educational attainment than was the case among those scientists who matched their fields of study and employment. To answer this question the data were transposed in the form of cumulative percentage distributions in Table 4.5. We learn from the cumulative percentage distributions that:

a) Sex roles were more important in determining educational attainment by 1960 than was the factor of correspondence between field of study and field of employment in the physical sciences, biological sciences and mathematics but not among social scientists. In the latter field, having one's highest degree line up with the occupation group took precedence over sex roles in achieving the 1960 educational status. As an example of the precedence of sex over correspondence between field of employment and field of study in determining educational attainment, note that 1960 male mathematicians with highest degrees in "other" fields more frequently held the master's (40 per cent) than did women with their highest academic degrees in mathematics (34 per cent).

b) Controlling for correspondence between field of study and field of employment, sex differences in educational achievement were maintained in every occupation group and for every level (twenty-eight out of thirty comparisons on entry to graduate school, receipt of the master's, and possession of the doctorate).

c) Controlling for sex, scientists with highest degrees in fields of study that matched their 1960 occupation group achieved higher academic levels by 1960, their counterparts lacking this match between fields.

Again it is not entirely clear from the data on hand why the social scientists did not conform to the pattern found among the remaining three occupation groups in the relative importance of sex roles vis-a-vis coherence of fields of study and employment. Note that social scientists and mathematicians had similar proportions of women, yet the two occupation groups diverged in the pattern of attainment. One clue is provided by our data: women in social science occupation groups were significantly older than women in mathematics and accordingly had more time to "catch up" academically with their male counterparts. (Some 72 per cent of the female social scientists were over age 35 in 1960 in contrast to 58 per cent of the female mathematicians [Warkov, in press, Chapter 2].)

TABLE 4.5

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED IN SELECTED FIELDS OF SPECIALIZED STUDY, BY EDUCATIONAL ATTAINMENT (1960), BY SEX AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960)	Field of Specialized Study	Sex	Cumulative Per Cent			Weighted Number of Persons
			Bachelor's Plus	Master's	Doctorate	
Physical scientists	Chemistry . .	Men	67	41	26	41,075
		Women	59	24	9	4,503
	Other physical sciences . .	Men	77	51	24	25,920
		Women	73	57	23	662
	Other fields . . .	Men	71	34	11	12,938
		Women	63	27	9	1,021
Biological scientists	Biological sciences . .	Men	91	77	52	11,161
		Women	66	48	21	2,277
	Other fields .	Men	74	50	19	9,514
		Women	64	28	5	1,157
Mathematicians	Mathematics .	Men	81	56	21	10,074
		Women	54	34	7	2,393
	Other fields .	Men	73	40	11	7,556
		Women	58	32	4	2,105
Social scientists	Psychology . .	Men	99	88	53	8,990
		Women	96	87	41	2,988
	Social sciences . .	Men	94	82	51	13,949
		Women	84	65	30	2,539
	Other fields . . .	Men	90	66	25	14,497
		Women	81	70	11	6,216

N	181,535
NA.	9,829
Degree exclusions	83,401
Total scientists. . . .	274,765

Occupation Group, Educational Attainment, Field of Study, and Age

Because the relationship between field of study for the highest degree held in 1960 and the field of employment in 1960 as indicated by occupation group affiliation is a topic that is central to the Postcensal survey, we consider in this section whether age group intersected the relationship between field of study for the highest degree held and field of employment.

First, the question of possible age differences that affected the level of congruence between field of study and occupational affiliation: Examination of the data in Table 4.6 shows that among the four scientific occupation groups, the overlap between field of study and occupation group at every age was more evident at the doctoral level than at the bachelor's level while the opposite was the case among engineers. The table presents the proportion in each occupation group holding their highest degree in "other" fields, controlling for age and educational level. For example, the panel for mathematicians indicates that among those aged 45 to 54, three out of four (76 per cent) holding the bachelor's as their highest degree received this training in "other" fields of specialized study while only one out of four at the doctoral level in this age group held this degree in fields of study other than mathematics. Also, there was an age-related trend and these age differences were more pronounced in certain occupation groups than in others, more evident at certain academic levels and minimal at others.

Knowing that there were age differences as well as differences by academic level in the extent of concentration of fields of study in each of the five 1960 occupation groups, we consider whether field origins made a difference among those employed in these occupations in 1960 in the extent of their educational advancement in each age group. Once again, the data were refashioned in the form of cumulative percentage distributions and are presented in Table 4.7. The cumulative percentage distributions in the five sections for each of the occupation groups indicate that age was less important in determining educational attainment by 1960 than was the factor of correspondence between field of study and field of employment. In every case, educational attainment varied directly with age, the younger incumbents (less

TABLE 4.6

SELECTED FIELDS OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE, BY EDUCATIONAL ATTAINMENT (1960), AGE (1960), AND OCCUPATION GROUP (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Field of Specialized Study	Educational Attainment and Age Group											
		Bachelor's			Bachelor's Plus			Master's			Doctorate		
		25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54
Engineers	N	93,752	83,520	25,565	59,712	46,749	17,064	20,967	18,008	6,876	2,306	3,002	1,185
	Engineering	86	88	82	82	79	78	79	73	65	76	74	37
	Other fields. . . .	14	12	18	18	21	22	21	27	35	24	26	63
Physical scientists	N	11,012	9,120	3,469	11,521	7,896	2,974	7,445	6,680	2,850	6,093	7,877	3,208
	Chemistry	51	52	67	44	42	44	33	43	36	54	60	58
	Other physical science	27	23	13	29	25	17	49	35	30	37	31	31
	Other fields	22	25	20	27	33	39	18	22	44	9	9	11
Biological scientists	N	1,708	1,436	590	1,776	1,222	656	2,574	2,248	1,122	2,115	3,484	1,457
	Biological science.	38	35	25	45	31	35	57	45	51	85	73	78
	Agriculture	44	49	48	27	31	31	30	34	28	8	17	11
	Other fields . . .	18	16	27	28	38	34	13	21	21	7	10	11
Mathematicians	N	2,272	1,285	729	2,868	1,177	590	2,724	2,257	1,062	839	1,204	807
	Mathematics	54	40	24	54	40	40	67	62	43	79	65	75
	Other fields. . . .	46	60	76	46	60	60	33	38	57	21	35	25
Social scientists	N	1,872	1,425	733	3,346	1,633	999	6,238	6,932	3,610	3,522	7,294	4,344
	Psychology.	6	1	5	18	17	5	34	22	12	54	32	27
	Social sciences . .	22	28	20	27	29	30	27	34	20	31	44	52
	Other fields. . . .	71	71	75	55	54	65	39	44	68	15	24	21

N	538,996
NA	235,225
Age and degree exclusions . . .	380,286
Total N.	1,154,507

than thirty-five years old) always reporting lower levels of achievement than older scientists and engineers. But age as a factor in educational attainment of these 1960 engineers and scientists was of secondary importance, producing differences in extent of academic progress only after field of study was accounted for. In contrast, sex roles were more important than field of study in determining levels of attainment in each of the scientific occupations except social sciences. Since age was only of minor importance, it is clear that a joint consideration of the effects of age, sex, and field of study would yield more precise statements on educational ports of entry to and exit from these occupation groups.

Summary

Chapter 4 dealt with two related questions: To what extent was the field of specialization for the highest degree attained in 1960 similar to the occupation group in which scientists and engineers were employed at the time the Bureau of the Census conducted the 1960 Census of Population? To what extent was the field of specialization for each degree attained similar? What, in effect, were the various concentrations, within each category of age, sex, and educational level, and for each occupation group, for the highest and for each degree attained?

Considering the highest degree held, the initial finding was that the great majority of those employed in the five occupational groups held degrees in fields of specialized study that coincided with the occupational classification employed in the study. The range in the extent of concentration was from a high of 83 per cent of the engineers to a low of 56 per cent of the mathematicians holding an academic degree in a field coinciding with their 1960 occupation group.

In terms of the educational attainment of the persons in each occupation group, increasing concentration by rising academic degree was found except among the engineers. Moreover, in each of the occupation groups, except engineering, persons holding their highest academic degree in 1960 in their occupational classification were more likely to have attained higher levels of academic training than their fellows in other fields of study. Where sex differences were considered, it was evident that educational attainment was

TABLE 4.7

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED, IN SELECTED FIELDS OF SPECIALIZED STUDY, BY EDUCATIONAL ATTAINMENT (1960), AGE (1960), AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960)	Field of Specialized Study	Age Group (1960)	Cumulative Per Cent			Weighted Number of Persons
			Bachelor's Plus	Master's	Doctorate	
Engineers	Engineering	25-34	44	12	1	152,391
		35-44	41	12	2	128,140
		45-54	44	12	1	41,752
	Other fields	25-34	53	17	2	29,904
		35-44	58	21	3	26,422
		45-54	57	26	6	12,130
Physical scientists	Chemistry	25-34	66	35	20	16,498
		35-44	69	48	30	15,686
		45-54	64	44	28	6,555
	Other physical science	25-34	76	48	18	12,148
		35-44	76	54	27	8,890
		45-54	84	66	35	2,802
	Other fields	25-34	66	25	7	7,601
		35-44	66	30	10	7,322
		45-54	76	41	11	3,250
Biological scientists	Biological science	25-34	86	69	38	4,744
		35-44	89	80	58	4,440
		45-54	93	82	55	2,082
	Agriculture	25-34	66	43	7	2,131
		35-44	71	56	24	2,444
		45-54	70	49	16	949
	Other fields	25-34	73	37	12	1,345
		35-44	84	53	22	1,521
		45-54	80	51	21	794
Mathematicians	Mathematics	25-34	76	47	12	5,280
		35-44	84	69	24	3,175
		45-54	87	71	40	1,495
	Other fields	25-34	69	31	5	3,527
		35-44	70	45	15	2,815
		45-54	66	46	12	1,750
Social scientists	Psychology	25-34	98	85	40	4,747
		35-44	100	93	57	4,122
		45-54	97	94	68	1,697
	Social science	25-34	90	77	26	4,064
		35-44	94	86	50	6,397
		45-54	96	87	66	3,399
	Other fields	25-34	77	48	9	6,258
		35-44	85	72	26	6,795
		45-54	88	74	21	4,604

N	552,066
NA.	222,682
Age and degree exclusions . . .	379,759
Total N.	1,154,507

still the primary correlate of concentration, but that they worked to confound the relationship in certain fields, though not in others. The overlap between field of study and occupational classification was increasingly extended with each successively higher level of academic attainment, and was more evident among men than among women at the lower levels, while the reverse was true in the upper reaches.

Consequences for educational attainment of securing a degree in fields of study outside the occupation group of employment were examined: Use of cumulative percentage distributions indicated that sex roles were more important in determining educational attainment by 1960 than was the factor of correspondence between field of study and occupation group in the physical sciences, biological sciences, and mathematics, but not in the social sciences. Conversely, scientists with degrees in fields of study that coincided with their 1960 occupation group affiliation were more likely to be at higher levels of academic achievement than their counterparts holding degrees in other fields when the factor of sex was removed from consideration.

For each of the occupation groups, age was less important in determining educational attainment by 1960 than was congruence between field of study and the 1960 occupation. In general, concentration varied by academic level; congruence between field of study and occupation group yielded higher levels of academic attainment than was the case when field discrepancies occurred. Age differences only affected this trend in a secondary way. Sex roles were far more important in securing advanced training than maintaining correspondence between field of study and occupational affiliation.

CHAPTER 5

SOURCES OF SUPPORT FOR UNDERGRADUATE AND GRADUATE EDUCATION

Financial support for higher education is the concern of all private and public institutions responsible for increasing the supply of manpower in the scientific, technical, and engineering fields. A number of studies have documented the extent to which graduates of American schools of higher education rely on stipend support to permit full-time study (Davis, 1962; Warkov, 1964). They conclude that talented students who successfully complete at least four years of study in a college of arts and science need not defer their advanced training or abandon a career in the scientific fields for want of financial support.

Although this may be the case for arts and science graduates in the past ten years, more information is needed on sources of support for undergraduate and graduate training of persons in the experienced civilian labor force who are employed in the scientific, technical, and engineering fields. To meet this need, this sample of engineers and scientists was asked to report the source of support they judged the most important for their college and graduate level training and how many sources were relied on for training at each level.

Sources of Support for Undergraduate Training

The replies to a multiple response question[1] asking, "How did you finance your post-high school training?" show a similar rank order in the frequency with which a variety of sources were mentioned by workers in each occupation group, although there were occupational variations in the proportions reporting each source (see Table 5.1). The sources were:

1. Aid from parents or relatives: 54 per cent of the engineers relied on kin to pay their college expenses, the percentage rising to 64 among the social scientists.

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[1] See Question 7, p. 6, of the questionnaire in Appendix 1.

TABLE 5.1

SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE TRAINING, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

Source of Financial Support	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
Aid from parents and relatives	54	63	63	60	64
Earnings while attending school	55	53	55	51	54
VA benefits	37	27	28	24	23
Savings from previous employment	42	42	46	33	39
Scholarship or fellowship:.	14	23	22	25	26
from college or university	10	19	17	21	21
from Federal agency.	4	4	5	4	5
Loans	9	11	13	10	13
Employer paid	5	3	1	4	2
Research or teaching assistantship	2	7	8	4	5
Other sources	5	4	4	6	5
Total[a]	223	233	240	217	231
Base N	717,529	120,834	29,455	31,794	61,846

N	961,458
NA, sources	59,455
No college attendance . .	133,594
Total N	1,154,507

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[a] Total exceeds 100 per cent because of multiple responses.

2. Own earnings from employment while attending school (except assistantship): 51 to 55 per cent of each occupation group worked part time or full time during college.

3. Own savings from previous employment (including earnings between school terms): as many as 46 per cent of the biological scientists used their savings for college, this percentage dropping to 33 among mathematicians.

4. Veterans Administration benefits (G.I. Bill or Vocational rehabilitation): 37 per cent of the engineers financed their college education in part through the G.I. Bill or another program of the VA. Among the physical and biological scientists the extent of VA support was 27 to 28 per cent, and among the social scientists, 23 per cent.

5. Scholarship or fellowship from college or university: only 10 per cent of the engineers reported receiving this support, in contrast to 17 per cent of the biological scientists and 20 per cent of the remaining occupations.

6. Loans: from 9 to 13 per cent in each occupation checked loans as a source of support for undergraduate training.

Other sources of financing included scholarships or fellowships from a Federal agency (mentioned by 4 to 5 per cent) and research or teaching assistantships.[2] Fewer engineers received the latter support (2 per cent) than did physical and biological scientists (7 to 8 per cent) or mathematicians and social scientists (4 to 5 per cent). Employer-paid training was mentioned by only one out of twenty engineers and by proportionately fewer workers in the remaining occupation groups.

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[2] Two caveats are necessary in evaluating responses to the question on sources of support. First, there are several classifications currently in use of stipend support, i.e., scholarships, fellowships, and assistantships; therefore, a literal reading of the proportions reporting one rather than another type of stipend support would not be justified. Second, the question distinguished among several institutional sources providing scholarships and fellowships (e.g., Federal agency, college, or university), but assistantships, both teaching and research, were not classified by institutional source. It is not possible to provide an estimate of the extent to which workers in these five occupation groups benefited from all forms of stipend support provided by Federal and non-Federal sources.

2

Most Important Source of Support for Undergraduate Training

The previous section identified the extent to which various sources were used by engineers and scientists to support their college training, but it indicated nothing about the relative importance of any particular source. In addition to the multiple response question asking the respondent to check off all sources of support used for his undergraduate training, information was secured on the sources the worker considered most important.

Did the pattern of support found in the examination of all sources supporting college level training hold for the single most important source? Table 5.2 indicates a consistent pattern in the rank order, mentioning the various sources of support among all occupation groups except the engineers. Parental support was the more prominent of these sources, ranging from 29 per cent among the engineers to 40 per cent among the mathematicians. Second in importance was income from a job while attending college; one out of every five scientists relied on this source. In contrast, one out of four engineers received aid from the VA in addition to their earnings. The Veterans Administration ranked third as the most important financial source among all the scientists, with 15 to 19 per cent in each group receiving this aid. Support from savings was the fourth ranking source for all groups except the mathematicians; among the latter, scholarships or fellowships from colleges and universities were ranked fourth.

The importance of savings was emphasized by 7 per cent of the mathematicians and 11 per cent of the engineers and biological scientists. The next ranking source of support for college level training was the nonduty stipend provided by the school, cited by 3 per cent of the engineers and 8 per cent of the mathematicians as the most important financial source for

TABLE 5.2

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR UNDERGRADUATE TRAINING, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

Source of Financial Support	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
Aid from parents and relatives	29	37	36	40	38
Earnings while attending school . .	24	20	21	22	22
VA benefits	25	18	19	15	16
Savings from previous employment .	11	10	11	7	8
Scholarship or fellowship:	5	8	7	10	9
from college or university	3	6	5	8	7
from Federal agency	2	2	2	2	2
Loans	2	2	3	2	3
Employer paid	2	1	1	2	1
Research or teaching assistantship	0	1	2	1	1
Other sources	2	2	1	3	2
Total	100	99	101	102	100
Base N	719,203	120,880	29,486	31,565	61,939

N	963,073
NA, other	57,840
No college	133,594
Total N	1,154,507

undergraduate training. The remaining sources--research or teaching assistantships, scholarships or fellowships from Federal agencies, loans and finances from an employer--all contributed less than 4 per cent of the support in any occupation group.

Thus parental support and income from work while attending school were the most frequently mentioned among all sources of support and also were designated as the two single most important sources of support for undergraduate training.

All Sources of Support for Graduate Training

Information about sources of support for undergraduate training among workers in the scientific and engineering groups was supplemented by data on sources of funds for any post-baccalaureate or graduate training. Table 5.3 presents these data. Contrary to our findings concerning undergraduate finances, here we find considerable variation in the proportions mentioning these various sources. Social scientists and engineers most frequently mentioned earnings while attending school. In each occupation, almost one out of two workers relied on this source to some extent. Social scientists also pointed to support from research and teaching assistantships (40 per cent) and savings (39 per cent), while the second rank for the engineers was aid from the Veterans Administration (28 per cent) followed closely by savings (25 per cent) and finances from an employer (26 per cent). The fifth rank for both occupation groups was aid from parents or relatives, 17 per cent of the engineers and 32 per cent of the social scientists receiving this form of support.

Physical and biological scientists and mathematicians showed similar patterns in the rank order mentioning these three sources of support: first, research and teaching assistantships; second, earnings while attending school; and third, savings.

TABLE 5.3

SOURCES OF FINANCIAL SUPPORT FOR GRADUATE TRAINING, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

Source of Financial Support	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
Aid from parents and relatives	17	27	27	24	32
Earnings while attending school . .	48	36	35	39	49
VA benefits	28	26	33	30	36
Savings from previous employment	25	33	33	33	39
Scholarship or fellowship:	12	33	35	36	37
from college or university	8	20	21	18	25
from Federal agency	4	13	14	18	12
Loans	4	9	10	9	13
Employer paid	26	8	6	14	5
Research or teaching assistantship	16	50	58	42	40
Other sources	3	4	4	6	6
Total[a].	179	225	241	233	257
Base N	143,460	64,375	20,850	17,631	50,527

N	296,843
NA	96,663
No graduate training .	761,001
Total N	1,154,507

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[a] Total exceeds 100 per cent because of multiple responses.

The Most Important Source of Finances for Graduate Training

In discussing all sources of aid for graduate training, it was found that the physical and biological scientists and the mathematicians were more similar to each other in rank order relationships than they were to the social scientists and engineers, and that the two latter groups shared hardly any of the same rankings. This still held true, but the significant sources showed a different pattern.

For example, "earnings while attending school" ranked first in the proportions among all five occupation groups mentioning it as a source of support, but research and teaching assistantships were most frequently mentioned in three of the four scientific occupation groups as the single most important source of support for graduate level training. Among the engineers and social scientists, earnings while attending school were reported to be the single source providing the most support (see Table 5.4).

Types of Support for Undergraduate and Graduate Level Training

Data on sources of support can be re-examined if we combine information on hand concerning (1) the presence or absence of certain sources of support, and (2) the chances that it was reported as the single most important source of support. These two dimensions are shown in each of the two figures of Charts 5.1-5.5. The vertical axis in each chart is the percentage of workers in each occupation group who reported a source among those providing support for college level training and for graduate level training, respectively. In like manner, the horizontal axis indicates the percentage who reported the source to be the single most important one. The vertical dimension in each figure can be thought of as measuring "frequency" of a given type of financial support, while the horizontal dimension measures its "salience."

As can be seen in the charts, the two criteria were with a few exceptions not strongly related, some sources high on one dimension and not on the other, and some low on both. There was substantial variation within

TABLE 5.4

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR GRADUATE TRAINING, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

Source of Financial Support	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
Aid from parents and relatives	8	10	7	8	10
Earnings while attending school . .	32	18	14	19	22
VA benefits	16	13	13	13	18
Savings from previous employment	10	8	8	10	12
Scholarship or fellowship:	7	16	15	15	14
from college or university	4	9	9	8	10
from Federal agency	3	7	6	7	4
Loans	1	1	1	2	2
Employer paid	16	3	2	6	2
Research or teaching assistantship	10	30	38	24	18
Other sources	1	2	1	2	2
Total	101	101	99	99	100
Base N	142,701	64,177	20,874	17,616	50,602

N	295,970
NA, other	97,536
No graduate training .	761,001
Total N	1,154,507

CHART 5.1 FREQUENCY AND SALIENCE OF SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE AND GRADUATE LEVEL TRAINING: ENGINEERS

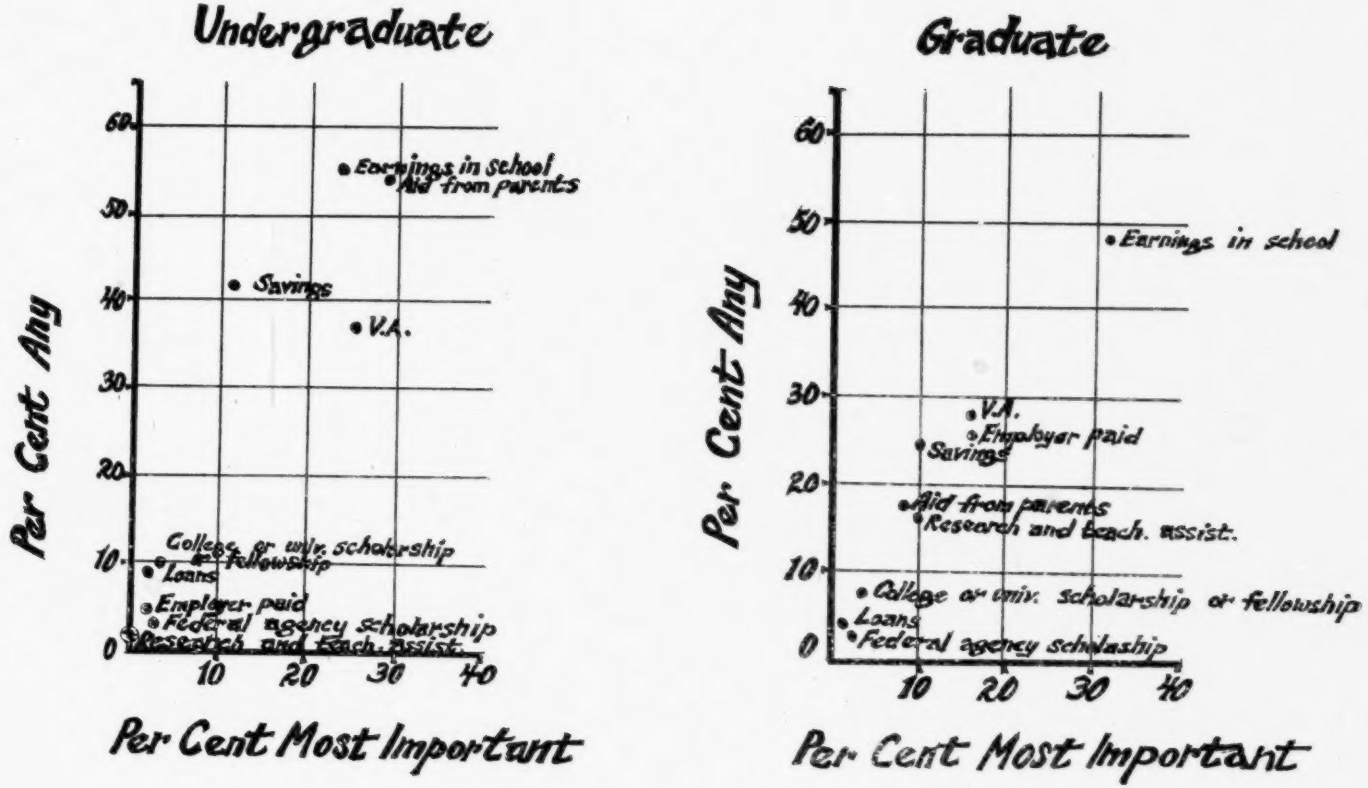


CHART 5.2 FREQUENCY AND SALIENCE OF SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE AND GRADUATE LEVEL TRAINING: PHYSICAL SCIENTISTS

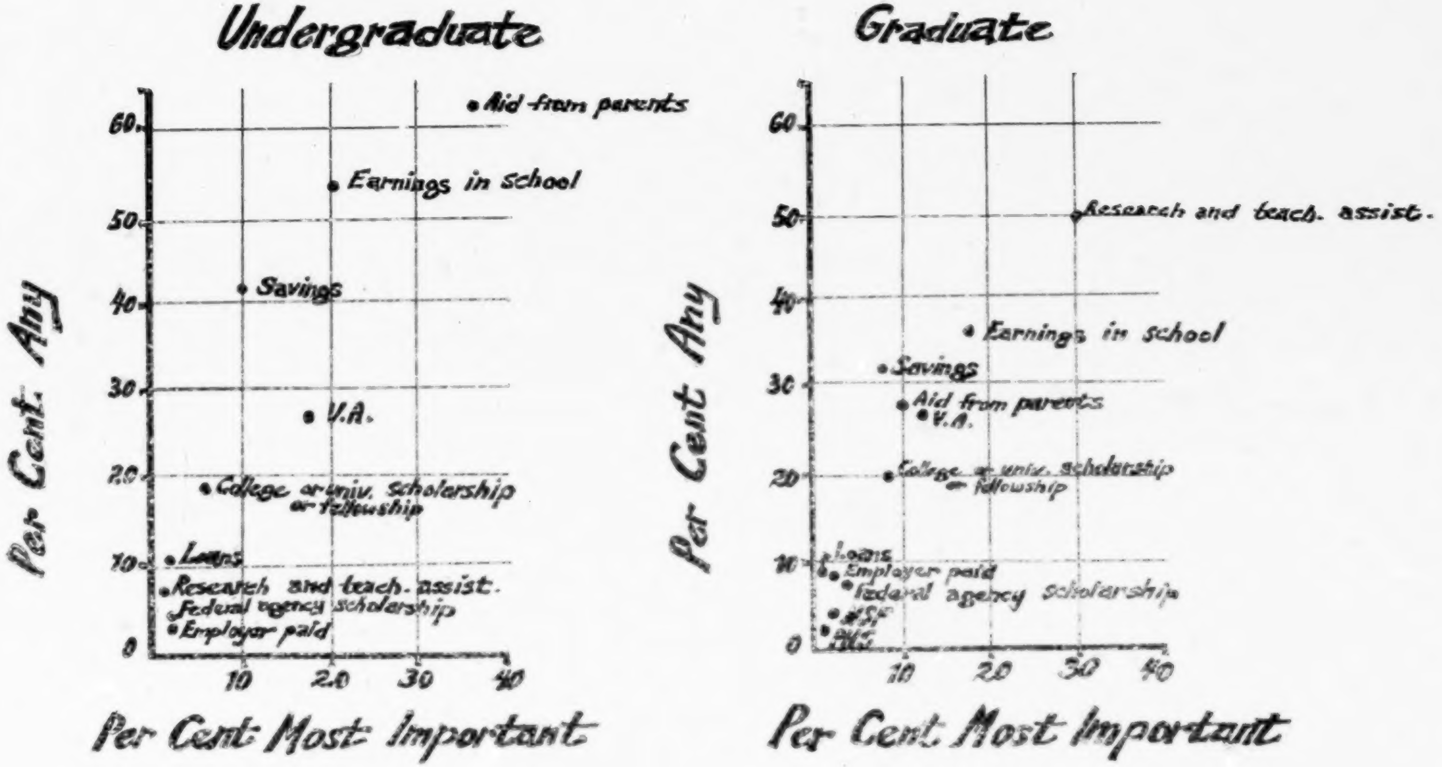


CHART 5.3 FREQUENCY AND SALIENCE OF SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE AND GRADUATE LEVEL TRAINING: BIOLOGICAL SCIENTISTS

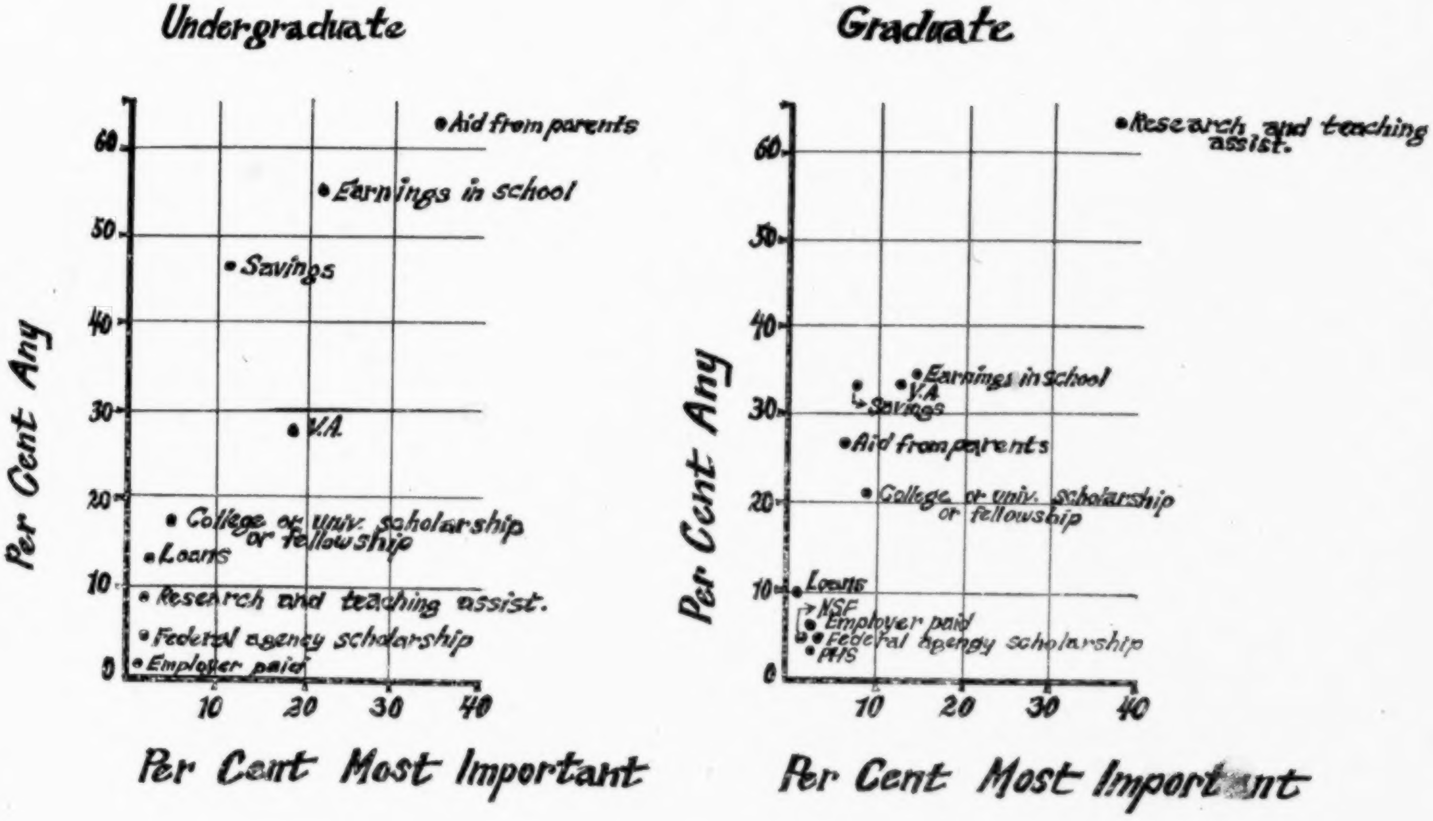


CHART 5.4 FREQUENCY AND SALIENCE OF SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE AND GRADUATE LEVEL TRAINING: MATHEMATICIANS

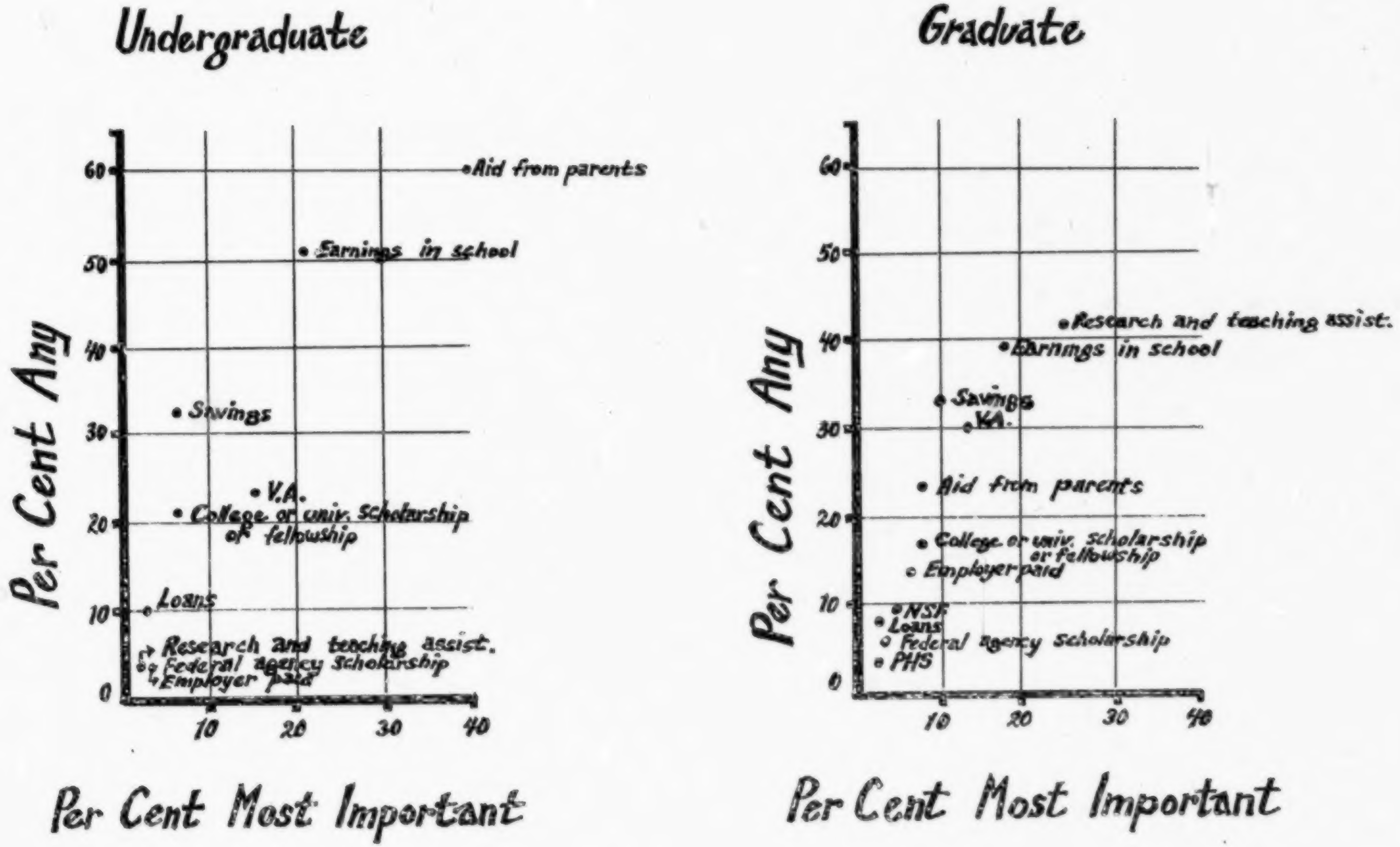
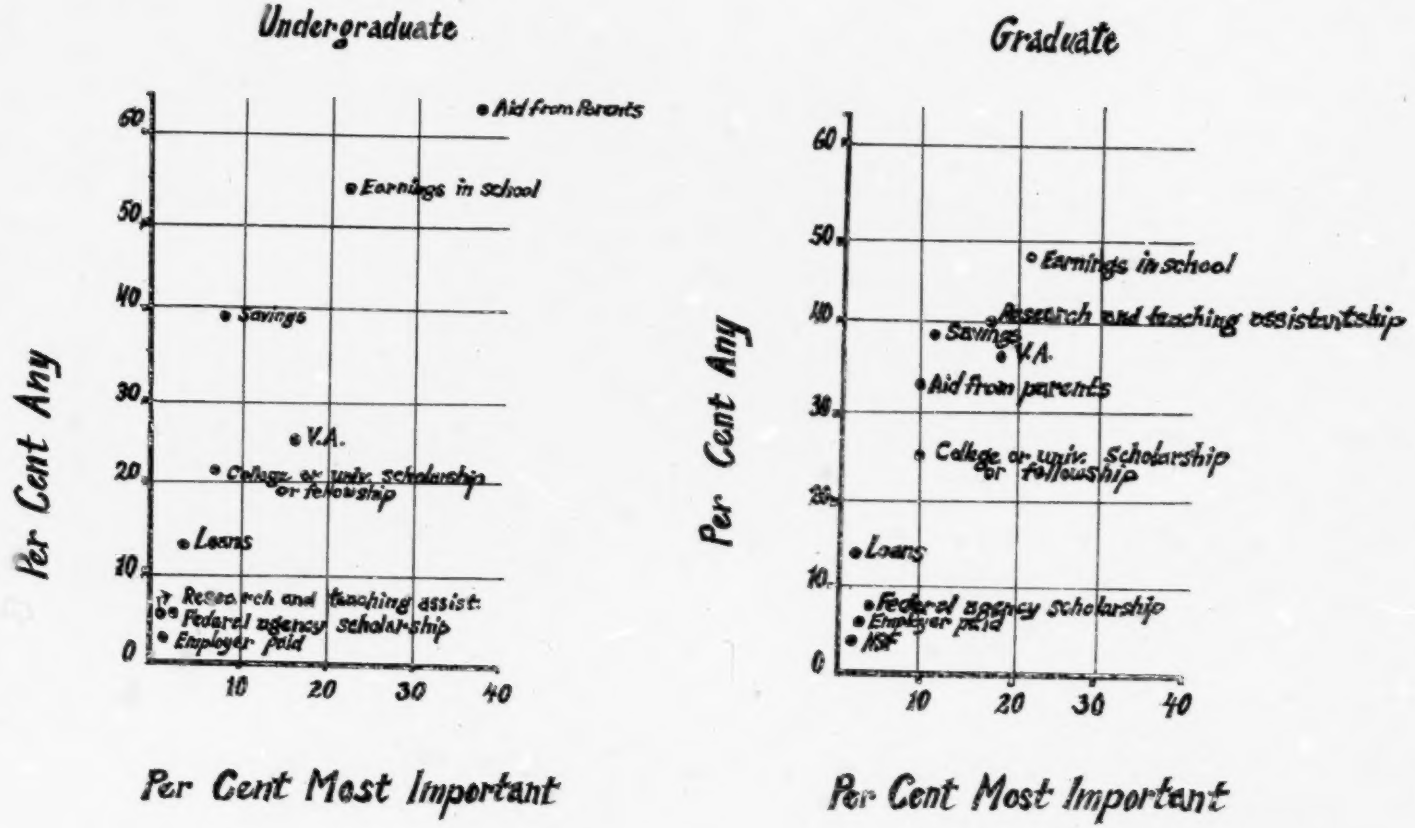


CHART 5.5 FREQUENCY AND SALIENCE OF SOURCES OF FINANCIAL SUPPORT FOR UNDERGRADUATE AND GRADUATE LEVEL TRAINING: SOCIAL SCIENTISTS



and between occupation groups in the typing of these various sources of support, together with considerable change in the classification of types of sources, if comparisons are made between undergraduate and graduate level training. One marked tendency, applicable to all four scientific occupation groups, was for "aid from parents or relatives" to show considerable frequency and salience at the undergraduate level, but to diminish greatly at the graduate level of training, while on the other hand, "research and teaching assistantship" moved from relatively minor importance at the undergraduate level to considerable significance along both dimensions at the graduate level.

Important Sources of Support and Educational Attainment, 1962

Undergraduate Training

Workers in these five scientific and engineering occupation groups showed distinctive patterns of support from a variety of sources for both undergraduate and graduate level education. Here, special attention is given to their evaluation of the single most important source of support for undergraduate training, taking into account their 1962 level of education. Were those holding the doctorate by 1962 more likely than their counterparts holding the bachelor's to attribute primary importance to certain sources of support for their undergraduate training?

The five panels of Table 5.5 provide this information and show a definite pattern. In general, the higher the level of attainment, the more likely were workers to consider a college or university scholarship or fellowship as the single most important source of support. Furthermore, in every group except the biological scientists, workers below the bachelor's level in attainment were much less likely than their occupational counterparts with the four year academic degree or more to consider aid from parents or relatives their single, most important source of financial support for undergraduate level training. This finding probably reflects socio-economic differentials in family origins of workers variously classified by educational attainment.

TABLE 5.5

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR UNDERGRADUATE TRAINING, BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

a) Engineers

Source of Financial Support	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	23	33	28	35	44
Earnings while attending school . . .	33	17	23	18	13
VA benefits	21	30	25	22	11
Savings from previous employment	11	10	11	11	7
Scholarship or fellowship:	4	5	7	8	19
from college or university	2	3	4	5	16
from Federal agency.	2	2	3	3	3
Loans	2	2	3	2	1
Employer paid	5	1	0	1	1
Research or teaching assistantship	0	0	0	0	2
Other sources	3	2	3	3	2
Total	102	100	100	100	100
Base N	228,422	255,953	143,264	69,040	9,469

N	706,148
NA source	46,024
No college . . .	127,570
Total N	879,742

TABLE 5.5--Continued

b) Physical Scientists

Source of Financial Support	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	27	37	37	39	43
Earnings while attending school . . .	31	17	23	17	14
VA benefits	14	25	18	18	13
Savings from previous employment	13	10	10	10	8
Scholarship or fellowship:	6	6	6	11	15
from college or university	3	5	4	8	12
from Federal agency . .	3	1	2	3	3
Loans	3	2	3	2	2
Research or teaching assistantship	0	1	2	1	3
Employer paid	3	1	1	0	0
Other sources	2	2	1	1	2
Total	99	101	101	99	100
Base N	16,929	31,761	24,569	23,566	22,962

N	119,787
NA, other	5,159
No college . . .	10,876
Total N	135,822

TABLE 5.5--Continued

c) Biological Scientists

Source of Financial Support	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	39	37	34	35	35
Earnings while attending school . . .	22	18	20	22	21
VA benefits	13	24	20	22	17
Savings from previous employment	13	11	13	10	10
Scholarship or fellowship:	4	4	7	5	10
from college or university	2	3	3	4	8
from Federal agency .	2	1	4	1	2
Loans	4	3	2	3	3
Research or teaching assistantship	0	1	2	2	3
Employer paid	2	0	1	0	0
Other sources	3	2	2	1	1
Total	100	100	101	100	100
Base N	2,464	5,292	3,680	7,648	10,011

N	29,095
NA, other	1,249
No college	2,535
Total N	32,879

TABLE 5.5--Continued

d) Mathematicians

Source of Financial Support	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	31	44	37	42	45
Earnings while attending school . . .	33	21	25	14	17
VA benefits	15	16	15	18	10
Savings from previous employment	7	7	7	8	6
Scholarship or fellowship:	4	8	8	13	14
from college or university	3	7	6	10	11
from Federal agency .	1	1	2	3	3
Loans	2	1	2	1	5
Employer paid	3	0	3	2	1
Research or teaching assistantship	0	-	1	1	1
Other sources	4	2	3	2	2
Total	99	99	101	101	101
Base N	5,583	6,931	5,218	8,748	4,640

N	31,120
NA, other	1,187
No college	5,426
Total N	37,733

TABLE 5.5--Continued

e) Social Scientists

Source of Financial Support	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	28	42	35	38	40
Earnings while attending school . . .	31	18	25	23	21
VA benefits	13	20	19	16	14
Savings from previous employment	13	7	7	8	8
Scholarship or fellowship:	4	8	7	9	11
from college or university	2	5	6	7	9
from Federal agency .	2	3	1	2	2
Loans	4	2	2	2	3
Employer paid	1	0	2	1	1
Research or teaching assistantship	1	1	1	1	2
Other sources	5	1	3	3	2
Total	100	99	101	101	102
Base N	4,774	5,930	6,041	21,989	22,811

N	61,545
NA, other	3,413
No college	3,373
Total N	68,331

In contrast to the above, college graduates, with the exception of biological scientists, were less likely to consider earnings from employment while attending school as their single most important source of support for college level training than were those attending college but not taking the bachelor's degree by 1962.

This also tended to be the case with respect to savings from previous employment (including that earned between school terms). Yet another pattern appeared in each occupation group with respect to Veterans Administration benefits: workers securing the bachelor's, the "bachelor's plus," or the master's degree were more likely to point to the importance of VA benefits than their counterparts at either end of the academic scale. In general, earnings and savings were correlated with relatively low levels of academic attainment by 1962; VA benefits in college correlated with intermediate levels of attainment; and aid from parents or family, or a scholarship or fellowship during the undergraduate years correlated with advanced levels of academic achievement by 1962.

In addition, there were distinctive differences between men and women in reporting the most important source of support for college level training even when educational level in 1962 was taken into account. As shown in Table 5.6, women more frequently than men considered a university scholarship or fellowship, or aid from parents or family as the single most important source of financing during the undergraduate years. On the other hand, men more frequently than women reported VA benefits, earnings from previous employment, and savings to have been the single most important source of support during the college years.

Graduate Level Training

Table 5.7 shows a change from undergraduate to graduate level education in the pattern designating single most important sources of support. Aid from parents or family no longer played a dominant role in graduate level education, although such support did prove to be important during the undergraduate years.

TABLE 5.6

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR UNDERGRADUATE TRAINING, BY EDUCATIONAL ATTAINMENT (1962), SEX, AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

a) Physical Scientists

Sources of Financial Support	No Degree		Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	26	50	35	62	36	56	38	46	43.	67
Earnings while attending school	32	19	18	6	24	8	17	13	15	0
VA benefits	15	0	27	0	20	0	20	0	13	0
Savings from previous employment	13	10	10	12	10	8	10	10	8	0
Scholarship or fellowship: .	6	9	6	15	6	18	10	29	15	16
from college or university	3	3	4	14	4	18	8	16	12	8
from Federal agency . . .	3	1	2	1	2	0	2	13	3	8
Loans	3	2	2	0	3	3	3	0	2	0
Employer paid	3	8	1	0	1	3	1	0	0	8
Research and teaching assistantship	0	1	1	0	1	3	1	1	3	8
Other sources	3	1	1	5	1	2	1	3	2	1
Total	101	100	101	100	101	101	101	102	101	100
Base N	16,252	677	28,944	2,317	22,971	1,598	21,791	1,775	22,426	536

N	119,733
NA, other	5,159
No college . . .	10,930
Total N	135,822

TABLE 5.6--Continued

b) Biological Scientists

Source of Financial Support	No Degree		Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	29	65	25	75	28	58	29	71	33	62
Earnings while attending school	25	17	22	7	23	9	24	10	22	10
VA benefits	18	1	32	1	25	2	25	2	18	2
Savings from previous employment	15	8	13	6	14	8	11	2	10	7
Scholarship or fellowship:	3	4	3	7	5	13	5	13	10	9
from college or university	2	0	2	5	2	5	3	13	8	9
from Federal agency . .	1	4	1	2	3	8	2	0	2	0
Loans	4	4	3	2	2	3	4	1	3	4
Employer paid	2	0	0	0	0	3	0	1	0	4
Research or teaching assistantship	0	0	1	0	2	4	2	1	3	1
Other sources	4	1	2	1	1	3	1	0	1	1
Total	100	100	101	99	100	103	101	101	100	100
Base N	1,746	718	4,020	1,272	2,964	716	6,570	1,078	9,424	587

N	29,085
NA, other	1,249
No college	2,545
Total N	32,879

TABLE 5.6--Continued

c) Mathematicians

Source of Financial Support	No Degree		Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	21	57	30	71	32	58	38	59	45	48
Earnings while attending school	36	24	27	12	29	7	15	13	18	0
VA benefits	21	2	23	2	18	2	22	0	10	0
Savings from previous employment	7	6	9	3	8	1	9	4	6	11
Scholarship or fellowship:	3	6	7	12	6	15	12	19	13	35
from college or university	2	5	6	10	4	13	9	17	10	28
from Federal agency .	1	1	1	2	2	2	3	2	3	7
Loans	3	0	2	1	2	3	1	0	5	7
Employer paid	4	1	0	0	2	4	2	4	1	0
Research or teaching assistantship	1	0	0	0	1	4	1	0	1	0
Other sources	5	4	3	1	3	5	2	1	2	0
Total	101	100	101	102	101	99	102	100	100	101
Base N	3,952	1,631	4,564	2,367	4,255	963	7,156	1,592	4,364	276

N	31,120
NA, other	1,187
No college . . .	5,426
Total N	37,733

TABLE 5.6--Continued

d) Social Scientists

Source of Financial Support	No Degree		Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	26	35	34	58	30	54	29	59	38	55
Earnings while attending school	31	29	17	19	26	20	28	12	21	16
VA benefits	16	1	31	0	23	2	22	1	16	1
Savings from previous employment	12	16	6	10	7	8	8	7	8	7
Scholarship or fellowship: .	4	6	8	8	8	11	8	10	10	15
from college or university	2	5	5	5	6	10	6	8	8	13
from Federal agency . . .	2	1	3	3	2	1	2	2	2	2
Loans	5	4	2	3	2	2	2	3	3	2
Employer paid	1	0	0	0	2	0	1	2	0	2
Research or teaching assistantship	0	4	1	1	1	1	0	1	2	1
Other sources	5	6	1	2	3	3	2	3	2	1
Total	100	100	100	101	102	101	100	98	100	100
Base N	3,662	1,112	3,919	2,011	4,793	1,248	15,249	6,740	19,571	3,240

N	61,545
NA, other	3,403
No college . . .	3,383
Total N	68,331

TABLE 5.7

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR GRADUATE TRAINING, BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

a) Engineers

Source of Financial Support	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	6	9	5
Earnings while attending school	37	28	23
VA benefits	15	18	11
Savings from previous employment	11	10	6
Scholarship or fellowship: .	3	8	18
from college or university	2	5	11
from Federal agency . . .	1	3	7
Loans	1	1	0
Employer paid	22	11	3
Research or teaching assistantship	3	15	37
Other sources	2	1	0
Total	100	100	100
Base N	67,405	65,365	9,730

N	142,500
NA, other	82,510
No graduate training.	654,732
Total N	879,742

TABLE 5.7--Continued

b) Physical Scientists

Source of Financial Support	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	13	11	7
Earnings while attending school	30	16	10
VA benefits	13	16	9
Savings from previous employment	12	9	4
Scholarship or fellowship:	12	17	25
from college or university	3	8	15
from Federal agency	9	9	10
Loans	2	2	1
Employer paid	7	3	1
Research or teaching assistantship	13	28	45
Other sources	2	2	1
Total	101	101	100
Base N	16,664	23,665	23,615

N	63,944
NA, other	9,117
No graduate training	62,761
Total N	135,822

TABLE 5.7--Continued

c) Biological Scientists

Source of Financial Support	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	10	8	6
Earnings while attending school	30	17	8
VA benefits	13	17	11
Savings from previous employment	13	10	6
Scholarship or fellowship: .	17	16	19
from college or university	7	7	10
from Federal agency . . .	10	9	9
Loans	2	1	1
Employer paid	7	3	1
Research or teaching assistantship	12	30	51
Other sources	1	1	1
Total	102	99	101
Base N	2,483	7,682	10,428

N	20,593
NA, other	1,511
No graduate training.	10,775
Total N	32,879

TABLE 5.7--Continued

d) Mathematicians

Source of Financial Support	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	9	9	5
Earnings while attending school	35	16	11
VA benefits	10	16	10
Savings from previous employment	9	12	7
Scholarship or fellowship: .	7	24	28
from college or university	1	8	14
from Federal agency . . .	6	16	14
Loans	2	2	3
Employer paid	16	5	1
Research or teaching assistantship	10	22	39
Other sources	3	3	1
Total	99	102	100
Base N	3,973	8,888	4,719

N	17,580
NA, other	1,512
No graduate training.	18,641
Total N	37,733

TABLE 5.7--Continued

e) Social Scientists

Source of Financial Support	Bachelor's Plus	Master's	Doctorate
Aid from parents and relatives	11	10	9
Earnings while attending school	34	24	18
VA benefits	16	18	18
Savings from previous employment	9	16	9
Scholarship or fellowship: .	13	12	21
from college or university	6	7	13
from Federal agency . . .	7	5	8
Loans	3	2	2
Employer paid	5	2	1
Research or teaching assistantship	9	15	23
Other sources	3	2	3
Total	101	100	102
Base N	4,662	22,025	23,749

N	50,436
NA, other	2,716
No graduate training.	15,179
Total N	68,331

Here we find that university scholarships, and fellowships and assistantships, of both the teaching and research variety, were considered to be of primary importance among workers in each of these scientific and engineering occupations, especially among those attaining the doctorate by 1962. Conversely, the following sources were less likely to be evaluated as critically important for graduate level training when the level of education attained by 1962 is taken into account: earnings, savings, and employer-paid training. Again, with the exception of 1960 social scientists, VA benefits were more prominent among workers holding the master's in 1962 than among "bachelor's plus" students or recipients of the doctorate.

Sex differences in evaluating the importance of these various sources are shown in Table 5.8. While women more frequently than men reported a university scholarship or fellowship as their most important undergraduate source of support, the pattern at the graduate level showed no consistent advantage accruing to either sex group compared across the five broad occupations. However, male physical and biological scientists were more likely than their female counterparts to attribute primary importance to a teaching or research assistantship, but no pronounced sex difference in evaluating assistantships appeared in the remaining occupation groups.

The more frequent male attribution of importance to earnings as a means of support for college level training did not carry over to graduate level academic training: women were as likely as men to rely primarily on earnings to finance their graduate level training. Furthermore, savings, employer-paid training, and aid from parents or family were more readily acknowledged by women as their single most important sources of support at the graduate level, while men invariably reported VA benefits as serving the same purpose.

TABLE 5.8

SINGLE MOST IMPORTANT SOURCE OF FINANCIAL SUPPORT FOR GRADUATE TRAINING, BY EDUCATIONAL ATTAINMENT (1962), SEX, AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Source of Support)

a) Physical Scientists

Source of Financial Support	Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	12	21	11	5	7	16
Earnings while attending school	29	34	16	19	10	5
VA benefits	14	0	17	0	10	0
Savings from previous employment	12	17	9	8	3	14
Scholarship or fellowship:	8	8	14	13	23	15
from college or university	3	0	8	9	15	15
from Federal agency	5	8	6	4	8	0
Loans	2	8	2	2	1	0
Employer paid	8	4	3	12	1	7
Research or teaching assistantship . . .	13	9	27	42	45	43
Other sources	2	0	2	1	1	1
Total	100	101	101	102	101	101
Base N	15,403	1,261	21,875	1,790	23,000	615

N	63,944
NA, other	9,117
No graduate training.	62,761
Total N	135,822

TABLE 5.8--Continued

b) Biological Scientists

Source of Financial Support	Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	7	19	7	13	5	12
Earnings while attending school	30	29	17	20	8	8
VA benefits	16	1	20	2	11	0
Savings from previous employment	13	13	9	12	6	5
Scholarship or fellowship:	12	16	12	23	16	25
from college or university	7	5	8	6	10	15
from Federal agency	5	11	4	17	6	10
Loans	2	2	1	2	1	0
Employer paid	7	7	2	6	1	3
Research or teaching assistantship	11	13	31	23	52	45
Other sources	1	1	1	2	1	3
Total	99	101	100	103	101	101
Base N	1,944	539	6,584	1,098	9,747	681

N	20,593
NA, other	1,511
No graduate training	10,775
Total N	32,879

TABLE 5.8--Continued

c) Mathematicians

Source of Financial Support	Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	6	21	9	13	4	9
Earnings while attending school	34	39	15	21	12	0
VA benefits	12	3	19	0	11	0
Savings from previous employment	8	13	12	9	7	11
Scholarship or fellowship:	5	8	13	25	22	52
from college or university	2	0	6	19	12	52
from Federal agency	3	8	7	6	10	0
Loans	2	0	2	3	3	9
Employer paid	18	5	5	5	1	0
Research or teaching assistantship	10	10	22	18	41	11
Other sources	4	1	2	5	0	9
Total	99	100	99	99	101	101
Base N	3,122	851	7,280	1,608	4,463	256

N	17,580
NA, other	1,512
No graduate training	18,641
Total N	37,733

TABLE 5.8--Continued

d) Social Scientists

Source of Financial Support	Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women
Aid from parents and relatives	9	19	9	14	9	9
Earnings while attending school	33	34	26	22	18	15
VA benefits	20	1	24	3	20	4
Savings from previous employment	5	22	11	27	7	17
Scholarship or fellowship:	12	10	10	13	17	26
from college or university	7	4	7	7	13	14
from Federal agency	5	6	3	6	4	12
Loans	3	1	2	1	2	2
Employer paid	6	2	2	4	1	3
Research or teaching assistantship . . .	9	8	15	15	23	21
Other sources	4	3	1	2	3	4
Total	101	100	100	101	100	101
Base N	3,623	1,039	15,338	6,687	20,416	3,333

N	50,436
NA, other	2,716
No graduate training.	15,179
Total N	68,331

Summary

Chapter 5 considered the various sources of monetary support and their relative importance in the undergraduate and graduate education of America's 1960 scientists and engineers.

A variety of sources of support for undergraduate level training were mentioned by workers in each occupation group. First was aid from parents or relatives, which was reported by 54 to 64 per cent of America's engineers and scientists, depending on occupation group. Next was own earnings from employment while attending school, 51 to 55 per cent; then, own savings from previous employment, 33 to 46 per cent, followed by VA benefits, 23 to 37 per cent; then scholarship or fellowship from college or university, 10 to 20 per cent; and loans, 9 to 13 per cent. Other sources were mentioned by less than one out of ten workers.

At the graduate level the sources most frequently mentioned were earnings while attending school; from 35 per cent of the biological scientists up to 49 per cent of the social scientists listed this as a source of financing for graduate training. Somewhat more frequently mentioned was research or teaching assistantships, ranging from 40 per cent among the social scientists to 58 per cent among the biological scientists, but considerably underreported by the engineers (16 per cent). Also mentioned by at least one out of ten workers were college or university scholarship or fellowship, loans, savings from previous employment, aid from parents or relatives, and VA benefits.

Data on the most important single source of financial support for undergraduate training indicated a consistent pattern in the rank order of proportions mentioning the various sources of support among all occupation groups, except the engineers. Parental support was the more prominent; second was a job while attending college, and VA support was third. A direct relationship between 1962 educational level and the proportion of an occupation group relying on a specific source for college level training held true only for support from scholarships and fellowships given by colleges and universities. Except among the physical scientists, women more than men at every education level relied on scholarships and fellowships from colleges and universities. Another major source of finance from which women consistently benefited more than men was aid from parents or relatives. Otherwise, the other important sources of funds for college training were mentioned less frequently by women than by men, in all occupation groups and at almost all education levels.

America's 1960 scientists and engineers reported research or teaching assistantships and earnings while attending school to be the most consistently important single source of financial support for graduate training. The former was mentioned by only 10 per cent of the engineers and by 18 to 38 per cent of the scientists. From 14 per cent of the biological scientists to 32 per cent of the engineers reported earnings while attending school. When educational attainment by 1962 was taken into consideration, research or teaching assistantships rose sharply in incidence of mention, just as earnings while attending school dropped off. This relationship of source of support to academic attainment was maintained among men and women alike.

Charts comparing all sources of financial support with the single most important source for undergraduate and graduate level training, among all five occupation groups, revealed some important changes in the relative significance of financial sources from undergraduate to graduate training. Thus aid from parents or relatives was important at the undergraduate level, but less so among those with graduate level training; research and teaching assistantships followed the opposite pattern.

CHAPTER 6

QUALIFICATIONS FOR 1962 EMPLOYMENT

This survey focuses on the relationship between educational and attainment and occupational affiliations: clearly, formal educational attainment importantly determines whether or not highly technical and scientific occupations are open to workers in the labor market. Yet, it is also true that qualifications necessary to enter certain employment hinge on other criteria as well, i.e., experience acquired on the job and in many cases supplementary training acquired outside the realm of formal degree programs. The purpose of this chapter is to describe how workers in these five scientific and engineering occupation groups evaluated these various types of qualifications for their 1962 employment. Specifically, they were asked the following question:

> Which of the following items listed below contributed most significantly to your becoming qualified for your present job?
>
> Special training or courses given by employer
>
> Course work at a technical institute, college, or university without acquiring a degree
>
> Acquired an A.A. degree or certificate from a technical institute or junior or community college
>
> Acquired a B.A., B.S., etc.
>
> Acquired a graduate or professional degree
>
> Post-high school courses at a vocational or technical high school
>
> Correspondence courses
>
> Military training applicable to civilian occupations
>
> Experience in present or related field of employment
>
> Other: specify

Needless to say, these data are of a different order than the factual information on educational attainment analyzed in previous chapters. Nevertheless, much can be learned about the efficacy of various types of training through an evaluation offered by scientific and technical workers about the jobs they held.

As usual, the findings were elaborated in terms of occupation group, academic attainment, sex, and age group. Table 6.1 shows the distributions, by occupation group, of the most significant educational experiences contributing to the 1962 job: formal training and work experience were the two most important factors in qualifying for 1962 employment. The finding obtained across occupation groups, although there was some interoccupational group variation. For example, engineers reported work experience one of the significant contributors to their 1962 situation with greater frequency (65 per cent), than did the other occupation groups (percentages ranged from 51 for biological scientists to 56 for mathematicians). In contrast, acquisition of a graduate or professional degree was considered significant by only 14 per cent of the engineers, while 36 per cent of the physical scientists, 37 per cent of the mathematicians, 58 per cent of the biological scientists, and no less than 71 per cent of the social scientists were so disposed.

The significance of the bachelor's degree in developing one's qualifications, according to the workers in the five 1960 occupation groups, also varied by occupation: social scientists were the least so inclined (39 per cent) while physical scientists (56 per cent) mentioned the bachelor's degree with the greatest frequency.

College work without a degree and special training by one's employer both received some attention, but less so than the previous items (see Table 6.1).

Reading across the rows of Table 6.2, there were clear-cut and very large differences in the perceived importance of various educational experiences among incumbents of different educational attainment. This held, although in different ways, for each of the five types of experiences selected[1] in every occupation group. Specifically, experience and

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[1] Remaining experiences were excluded because they were infrequent.

TABLE 6.1

TYPE OF EXPERIENCE AND TRAINING CONTRIBUTING TO QUALIFICATIONS FOR 1962 JOB, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Type of Experience and Training)

Type of Experience	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
Present or related field	65	53	51	56	55
College work without degree . .	18	15	13	17	13
Bachelor's degree	48	56	54	43	39
Graduate or professional degree	14	36	58	37	71
Course work at technical institute	11	4	3	4	2
Course work at junior or community college	3	2	2	3	1
Post-high school courses at vocational or technical high school	4	1	1	2	1
Correspondence courses	9	3	1	3	2
Special training by employer . .	21	13	11	17	8
Other	4	4	4	7	4
Total	197[a]	187	198	189	176
Base N	823,779	125,789	30,007	32,822	62,326

N	1,074,723
NA, qualifications	38,607
Not employed	41,177
Total N	1,154,507

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[a] Percentages total more than 100 because multiple responses were permitted.

TABLE 6.2

SELECTED TYPES OF EXPERIENCE AND TRAINING CONTRIBUTING TO QUALIFICATIONS FOR 1962 JOB, BY EDUCATIONAL ATTAINMENT (1962), AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Type of Experience and Training)

Types of Experience	Engineers					Physical Scientists					Biological Scientists					Mathematicians					Social Scientists				
	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Experience in present or related field	74	57	61	63	55	61	52	58	52	41	60	52	56	52	46	66	57	63	53	38	73	62	62	52	60
College without degree	31	5	13	7	7	32	8	18	12	3	26	10	22	13	6	28	9	22	14	6	24	6	25	14	7
Bachelor's degree	8	83	81	64	39	11	89	88	57	27	11	92	86	61	37	4	75	78	52	24	9	75	65	46	29
Graduate or professional degree	4	9	15	73	91	5	3	9	83	93	10	3	14	85	96	3	4	8	81	97	11	4	27	90	96
Special training by employer . .	31	14	16	10	1	28	12	14	9	1	37	18	13	8	1	27	24	19	7	1	32	13	12	4	2
Base N	339,803	252,687	139,696	68,474	9,905	24,492	30,504	23,849	22,758	23,189	3,724	4,947	3,408	7,357	10,201	8,634	6,302	4,669	8,227	4,606	6,636	5,368	5,574	20,964	23,410

N	1,058,384
NA, other	37,565
Not employed	40,826
Degree exclusions	17,732
Total N	1,154,507

formal training again elicited the greatest response among America's 1960 engineers and scientists, while college without a degree and training by one's employer again were of secondary importance.

Experience in present or related field.--In all occupation groups, the importance of this experience was most evident among those persons who lacked the bachelor's degree (from 60 per cent among the biological scientists to 74 per cent among the engineers), dropping off steadily and, in some cases, preceptibly as the level of academic attainment rose. Thus 55 per cent of the engineers holding doctorate degrees, 50 per cent of the social scientists, 46 per cent of biological scientists, and only 41 and 38 per cent respectively of the physical scientists and mathematicians holding doctorates were inclined to view this type of experience as contributing significantly to their 1962 role qualifications.

Acquired the bachelor's degree.--Whether or not acquisition of a bachelor's degree was viewed as a significant contribution to one's 1962 job operated as a consistent function of academic attainment. Not surprisingly, persons with the bachelor's as their highest degree were most likely to emphasize its importance for their 1962 employment qualifications while at each succeeding level of academic attainment this degree dropped preceptibly in importance. Thus, while recipients of the bachelor's degree ranged from 75 to 92 per cent approving (depending on 1960 occupational affiliation), recipients of the doctorate dropped from 24 to 39 per cent in their estimates of the significance of this experience.[2]

Graduate or professional degree.--Not unexpectedly, evaluations of this academic degree were directly opposite those above. For persons in the five occupation groups who possessed a graduate or professional degree, this was viewed as important in the attainment of their 1962 job situation. At the master's level, 90 per cent of the social scientists, 85 per cent of the biological scientists, 83 per cent of the physical scientists, 81 per cent of mathematicians, and 73 per cent of the engineers attributed enough significance to this educational experience to report it, while at the doctoral level 97 per cent of the mathematicians, 96 per cent each of the social and biological scientists, 93 per cent of the physical scientists, and 91 per cent of the engineers did so. At the lower levels of academic attainment, of course, the figures were in reverse, never exceeding 27 per cent, and in the main, no higher than 15 per cent (see Table 6.2 for detailed inspection).

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[2] Note that a number of those classified as having no four-year college degrees by 1962 responded that a bachelor's degree (similarly, a graduate or professional degree) made an important contribution to their work qualifications. This discrepancy can be explained, in part, by the classification of academic attainment: it was limited to degrees received no later than the 1961 calendar year. A number of these workers secured additional degrees in 1962, however, and responded in terms of their then current academic status during the spring and summer of 1962, when this study was in the field.

These findings are not as simplistic as they may at first appear; that is, that professional people, if they had the qualifications, considered them important. The significance of graduate or professional training culminating in a degree is brought into focus perhaps only when it is compared with the other important background experience factor: experience in present or related field. For here we see, in a comparison of the corresponding two rows of Table 6.2, that for all occupation groups the importance of experience (and presumably this is practical, on-the-job experience) varied inversely with graduate or professional training, i.e., formal training, holding academic attainment constant.[3]

College without a degree.--Again not surprisingly, persons in all occupation groups who lacked the bachelor's degree viewed this experience as significantly contributing to their 1962 job, while those on up the academic ladder increasingly disclaimed its significance. In general, this experience was accorded less attention at all academic levels of attainment and among all occupation groups than any of the prior experience factors.

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[3] This, of course, has interesting implications for the literature of the professions, because it relates, if indirectly, to the question whether formal training lies closer to the core of professionalism than practical experience; and the implication, at least insofar as these data are concerned, appears to be that it does.

Special training by employer.--In many ways employer training is akin to practical experience, and so, not surprisingly, responses on this item paralleled (although in lesser magnitudes) the prior findings, and as such, reiterated the suggestion that practical experience bears an inverse relation to formal training if academic attainment is held constant. Among scientists and engineers lacking the bachelor's degree, from 27 per cent of the mathematicians up to 37 per cent of the biological scientists, mentioned this experience. On the other hand, among recipients of the doctoral degree, only 1 or 2 per cent considered "special training by employer" important for their 1962 job.

Experience and Training, by Sex

Only minor sex differences occurred on the question of the significant educational contributions to one's current qualifications. Table 6.3 (identical to the previous table save that it differentiated by sex and dropped engineering for lack of female representation) offers eighty comparisons between men and women. As can be seen, the approximate similarities greatly outnumbered the sharp distinctions: in only seventeen of the eighty comparisons was there a difference of 10 per cent or more, and usually not much more. In overview, then, men and women of equivalent education offered similar evaluations of experiences contributing to 1962 job qualifications.

Comparisons by age group (not shown) indicated that evaluations of work experience contributing to qualifications for the 1962 employment were essentially the same among younger and older workers of equivalent educational attainment. This finding, that there were no essential age-related differences in evaluation, underscores the definitive role of educational attainment in the judgments that engineers and scientists offered of relevant work experience.

TABLE 6.3

SELECTED TYPES OF EXPERIENCE AND TRAINING CONTRIBUTING TO QUALIFICATIONS FOR 1962 JOB, BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Type of Experience and Training)

Types of Experience	Physical Scientists										Biological Scientists									
	Men					Women					Men					Women				
	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Experience in present or related field	61	52	58	52	40	56	42	46	54	53	62	54	57	53	46	55	45	52	51	43
College without a degree .	32	7	19	12	3	33	13	16	18	12	24	10	23	13	6	31	11	17	15	3
Bachelor's degree	11	89	88	57	27	7	91	90	60	31	11	92	86	61	36	9	91	84	61	39
Graduate or professional degreee	4	3	9	82	93	9	2	13	88	96	9	4	14	85	96	11	2	13	81	96
Special training by employer	28	11	14	9	1	30	19	10	12	0	33	16	11	7	1	50	23	22	9	2
Base N	23,415	28,310	22.420	21,125	22,614	1,077	2,194	1,429	1,633	575	2,868	3,937	2,853	6,380	9,583	856	1,010	555	977	618

	Physical Scientists	Biological Scientists
N	124,792	29,637
NA, other	4,158	1,540
Degree and age exclusions	6,872	1,702
Total N	135,822	32,879

TABLE 6.3--Continued

Types of Experience	Mathematicians										Social Scientists									
	Men					Women					Men					Women				
	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Experience in present or related field	68	59	61	55	39	62	52	76	45	15	74	65	61	52	50	69	55	65	51	56
College without a degree .	32	8	23	13	7	19	14	14	17	2	22	6	24	13	7	29	5	27	18	4
Bachelor's degree	5	72	78	52	23	2	81	76	49	47	6	68	62	45	29	17	92	73	47	24
Graduate or professional degree	4	4	9	81	97	0	4	5	82	100	10	3	26	90	96	13	5	32	92	97
Special training by employer	25	22	18	7	1	30	27	20	9	2	31	16	10	5	2	35	6	22	3	3
Base N	5,812	4,559	3,953	6,842	4,330	2,822	1,743	716	1,385	276	5,110	3,789	4,467	14,854	20,263	1,526	1,579	1,107	6,110	3,147

	Mathematicians	Social Scientists
N	32,438	57,353
NA, other	2,076	2,039
Degree and age exclusions .	3,219	8,939
Total N	37,733	68,331

Supplementary Training

Evaluations of work experience aside, many engineers and scientists supplement their formal training with other types of preparation. In this section, attention is given to the questionnaire item[4] designed to secure information on the types and subjects of preparation employed scientists and engineers have undertaken in the form of nondegree supplementary training.

Table 6.4 shows that a substantial minority of the workers in each scientific and engineering occupation group had received some form of supplementary training: among the engineers, over four out of ten (41 per cent) had done so by the time they returned their questionnaires to the Bureau of the Census, but most were closer to 30 per cent.

TABLE 6.4

SUPPLEMENTARY TRAINING OF PERSONS IN THE 1960 EXPERIENCED CIVILIAN LABOR FORCE, BY OCCUPATION GROUP (1960)

(Per Cent with Supplementary Training)

Occupation Group	Weighted Number of Persons	Received Supplementary Training
Engineers	876,731	41
Physical scientists	135,411	28
Biological scientists	32,776	29
Mathematicians	37,617	30
Social scientists	68,109	31
N	1,150,644	
NA, other	3,863	
Total N	1,154,507	

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[4] See question No. 11, p. 7 of the Questionnaire, Appendix 2.

Thus 31 per cent of America's 1960 social scientists, 30 per cent of the mathematicians, 29 per cent of the biological scientists, and only 28 per cent of the physical scientists reported some form of supplementary training.

Among all five occupation groups, persons below the master's level reported supplementary training in proportions approximating 30 to 40 per cent, while at the master's level the figures were closer to 30 per cent, and at the doctorate level the proportions were even lower--from 24 per cent among social scientists to a mere 8 per cent among mathematicians, with biological scientists at 18 per cent, engineers at 17 per cent, and physical scientists at 13 per cent (see Table 6.5).

When sex differences were considered (Table 6.6) there was relatively little change in the patterns already established. The overall pattern, then, was for men and women alike to receive supplementary training (compare Tables 6.5 and 6.6). In the four scientific occupation groups, both men and women, save for biological scientists, showed an especially low incidence of supplementary training at the doctoral level. Moreover, the trend for recipients of the bachelor's degree to participate in most supplementary training, with workers lacking a four-year degree and persons with some graduate training running close behind, was repeated again for both men and women. Six differences of ten percentage points or more occurred in four out of the twenty possible comparisons. Among the biological scientists 17 per cent of the male doctorate holders reported supplementary training, while among their female counterparts 28 per cent reported likewise. At the other end of the academic ladder, male and female social scientists without the bachelor's degree or with just the bachelor's also reported differently. While 42 per cent of the male social scientists without a degree indicated they had received supplementary training, only one out of four of their female counterparts did the same. Among social scientists with a bachelor's degree 45 per cent of the men reported supplementary training, compared with 34 per cent of the women.

TABLE 6.5

SUPPLEMENTARY TRAINING OF PERSONS IN THE 1960 EXPERIENCED CIVILIAN LABOR FORCE BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent with Supplementary Training)

Occupation Group	No Degree	Bachelor's	Bachelor's Plus	Master's	Doctorate
Engineers	43 (379,749)	38 (259,292)	42 (144,199)	34 (70,048)	17 (10,047)
Physical scientists . .	34 (29,232)	29 (32,180)	32 (24,879)	31 (24,016)	13 (23,946)
Biological scientists .	30 (4,971)	40 (5,338)	35 (3,706)	32 (7,881)	18 (10,474)
Mathematicians	29 (11,153)	41 (6,970)	42 (5,257)	27 (9,008)	8 (4,784)
Social scientists . . .	38 (8,575)	41 (6,129)	35 (6,132)	32 (22,829)	24 (24,036)

N 1,134,831
NA plus exclusions 19,676
Total N 1,154,507

TABLE 6.6

SUPPLEMENTARY TRAINING OF PERSONS IN THE 1960 EXPERIENCED CIVILIAN LABOR FORCE BY EDUCATIONAL ATTAINMENT (1962), SEX, AND OCCUPATION GROUP (1960)

(Per Cent with Supplementary Training)

Occupation Group	Educational Attainment, 1962									
	No Degree		Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Physical scientists	34 (27,485)	30 (1,747)	29 (29,355)	30 (2,825)	32 (23,281)	26 (1,598)	31 (22,221)	33 (1,795)	13 (23,287)	15 (659)
Biological scientists	28 (3,764)	37 (1,207)	42 (4,052)	33 (1,286)	35 (2,985)	36 (721)	32 (6,767)	32 (1,114)	17 (9,787)	28 (687)
Mathematicians . .	33 (6,668)	23 (4,485)	41 (4,610)	42 (2,360)	42 (4,303)	42 (954)	27 (7,360)	25 (1,648)	9 (4,508)	4 (276)
Social scientists	42 (6,278)	25 (2,297)	45 (3,999)	34 (2,130)	33 (4,869)	40 (1,263)	30 (15,743)	35 (7,086)	24 (20,642)	22 (3,394)

N	271,496
NA plus exclusions	3,269
Total N	274,765

Subject of Training

Sixteen specific subjects of supplementary training reported by workers in the five scientific and engineering groups are considered below.

Table 6.7 shows the proportion of each occupation group who had received or were receiving training in these selected subjects. As can be seen from the table, 31 per cent of the engineers reported "engineering" as a subject of supplementary training. Also, 9 per cent reported "business management," and 4 per cent reported "mathematics" and "skilled craft" training. The physical scientists show greater diversification; 13 per cent reported "physical science" as a subject of supplementary training; 8 per cent reported "engineering," and 5 per cent indicated extra training in "business management." Eighteen per cent of the biological scientists reported "biology and agriculture" as a subject of supplementary training, the only occupation group to give any attention to these subjects. Mathematicians as well showed an affinity for their own field; 15 per cent of the mathematicians reported "mathematics" as a subject of supplementary training, while 6 per cent reported "business and commerce" and 5 per cent indicated "engineering" and "business management." Social scientists also showed diversification in reporting subjects of supplementary training: 8 per cent said "psychology" was a subject of such training, and 8 per cent, too, reported "social science" other than psychology. Six per cent reported "business and commerce" a subject of extra training, 6 per cent reported "miscellaneous nontechnical training," and 5 per cent each reported "business management" and "all other" as subjects of supplementary training.

In total, there was a tendency for incumbents of a given occupation group to report supplementary training in subjects directly related to their occupation group, particularly the engineers, but there remained, nonetheless, wide diversification among subjects of supplementary training.

TABLE 6.7

SUBJECT OF SUPPLEMENTARY TRAINING OF PERSONS IN THE 1960 EXPERIENCED CIVILIAN LABOR FORCE, BY OCCUPATION GROUP (1960)

(Per Cent Listing Each Subject)

Occupation Group	Weighted Number of Persons	Subject of Supplementary Training															
		Engineering	Mathematicians	Statistics	Physical Science	Biology and Agriculture	Psychology	Medical Dental Health	Business and Commerce	Business Management	Communications	Skilled Craft	Drafting and Related	Miscellaneous Training	Social Sciences	Misc. Non-technical	All Others
Engineers . .	879,092	31	4	1	2	0	1	0	3	9	2	4	1	1	1	2	5
Physical scientists . . .	135,736	8	2	1	13	1	0	2	1	5	1	1	0	1	2	1	3
Biological scientists.	32,868	3	1	1	2	18	1	4	1	3	2	1	0	0	3	2	3
Mathematicians . . .	37,699	5	15	3	2	0	0	1	6	5	1	1	1	1	2	2	4
Social scientists . . .	68,264	2	2	1	1	1	8	1	6	5	2	1	0	1	8	6	5

N	1,153,659
NA, other	848
Total N	1,154,507

Selected Subjects of Supplementary Training by Academic Attainment

The five panels of Table 6.8 present some information on the subject of supplementary training among scientists and engineers classified by their highest academic degree attained by 1962. Subjects of training were limited in each panel to those reported by at least 5 per cent of the occupation group at any one level of academic attainment.

TABLE 6.8

SUBJECT OF SUPPLEMENTARY TRAINING OF PERSONS IN THE 1960 EXPERIENCED CIVILIAN LABOR FORCE, BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent Listing Each Subject)

a) Engineers

Edcuational Attainment	Weighted Number of Persons	Subject of Supplementary Training			
		Engineering	Mathematics	Business Management	Skilled Craft
No degree . .	380,778	35	3	9	6
Bachelor's . .	259,837	26	3	10	3
Bachelor's plus . . .	144,899	32	5	10	3
Master's . .	70,055	24	4	9	3
Doctorate . .	10,056	7	4	3	1

N	865,625
NA plus exclusions	14,117
Total N	879,742

TABLE 6.8--Continued

b) Physical Scientists

Educational Attainment	Weighted Number of Persons	Subject of Supplementary Training		
		Engineering	Physical Science	Business Management
No degree	29,281	9	15	3
Bachelor's . . .	32,236	8	13	6
Bachelor's plus .	24,937	10	14	8
Master's	24,075	9	17	6
Doctorate	24,055	4	5	3

N	134,584
NA plus exclusions	1,238
Total N	135,822

c) Biological Scientists

Educational Attainment	Weighted Number of Persons	Subject of Supplementary Training			
		Physical Science	Biology and Agriculture	Medical and Dental Health	Business Management
No degree . .	4,996	1	16	5	3
Bachelor's .	5,362	2	30	5	6
Bachelor's plus	3,716	4	22	7	5
Master's . .	7,881	3	19	4	3
Doctorate . .	10,507	2	11	2	1

N	32,462
NA plus exclusions	417
Total N	32,879

TABLE 6.8--Continued

d) Mathematicians

Educational Attainment	Weighted Number of Persons	Subject of Supplementary Training				
		Engineering	Mathematicians	Statistics	Business and Commerce	Business Management
No degree . .	11,158	4	6	4	6	6
Bachelor's .	7,004	3	27	4	12	7
Bachelor's plus	5,288	10	21	5	9	8
Master's . .	9,014	6	18	2	2	4
Doctorate . .	4,790	2	4	1	0	0

N	37,254
NA plus exclusions	479
Total N	37,733

e) Social Scientists

Educational Attainment	Weighted Number of Persons	Subject of Supplementary Training					
		Mathematicians	Psychology	Business and Commerce	Business Management	Social Science	Miscellaneous Non-technical
No degree . .	8,575	2	2	15	10	4	5
Bachelor's .	6,129	5	2	9	8	6	13
Bachelor's plus	6,139	5	6	7	5	8	9
Master's . .	22,881	2	10	5	4	10	7
Doctorate . .	24,132	1	9	2	3	8	2

N	67,860
NA plus exclusions	471
Total N	68,331

Among the five occupation groups, with the partial exception of the social scientists, the subject or subjects of supplementary training most frequently chosen were the ones most closely related to the 1960 occupation group affiliation. Engineers supplemented their training with engineering, physical scientists with physical science, and so on. Indeed, among three of the occupation groups--engineers, biological scientists, and mathematicians--choices in occupation-related subjects of supplementary training far overshadowed those in other kinds of supplementary training. And, by and large, this is true up and down the ladder of academic attainment. Again, supplementary training dropped off sharply at the doctoral level (with the exception of social scientists reporting "psychology" and "social science"); this was particularly the case among those subjects of training most closely akin to their respective occupation group affiliation.

Another earlier pattern, repeated here, was the bachelor's and "bachelor's plus" workers to report these subjects more frequently than their occupational counterparts at other academic levels.

In sum, a pattern was found of rather close affinity between subject or supplementary training and type of occupation pursued, a tendency for supplementary training to decline among recipients of the doctorate degree, and finally a rather strong tendency for workers with the bachelor's degree to overshadow their fellow workers in reporting supplementary training.

Summary

Respondents indicated educational and work-related experiences qualifying them for their 1962 job: Of the ten possible types of experience, formal training--either the bachelor's degree or graduate and professional degrees--and work experience--experience in present or related field--were easily the most significant and important factors contributing to the 1962 employment of America's scientists and engineers.

"Experience in present or related field" in all occupation groups was most extensively chosen among persons lacking the bachelor's degree, but dropped off steadily, and in some cases precipitously, with rising academic attainment. "Acquisition of the bachelor's degree" varied directly with academic attainment among all five occupation groups, such that it was most heavily reported at the lower educational levels, and least so at the higher levels. "Acquisition of graduate or professional degrees" likewise varied directly with educational attainment; the higher the degree attained, the more frequently it was reported as a significant contribution. "College without a degree" was esteemed by persons with college attendance but no degree among all five occupation groups, but not by others. Finally, "special training by employer" was evaluated very much like "experience in present or related field."

Among all five engineering and scientific occupational categories, holders of any type of supplementary training were in the minority. Thus 41 per cent of the engineers received supplementary training by 1962, as did 28 per cent of the physical scientists, 29 per cent of the biological scientists, 30 per cent of the mathematicians, and 31 per cent of the social scientists. Educational attainment was established as the most important single determining factor in determining whether supplementary training was secured. In each occupation group, supplementary training was most extensive among workers with no degree, the bachelor's degree, and among those with some graduate training; it diminished among recipients of the master's degree and dropped off at the doctoral level. The subject or subjects of supplementary training received most frequently coincided with the 1960 occupational affiliation, i.e., engineers supplemented their training in engineering, physical scientists with work in physical science, and so forth.

APPENDIX 1

THE QUESTIONNAIRE

Budget Bureau No. 41-6249; Expires December 31, 1962

This inquiry is authorized by Act of Congress (13 " S. C.). The report you submit to the Census ureau is confidential and may be seen only by sworn Census employees. It may not be used for purposes of taxation, investigation, or regulation.	Control No. (56)	FORM 1-56 (5-1-62) U.S. DEPARTMENT OF COMMERCE BUREAU OF THE CENSUS **POSTCENSAL STUDY OF PROFESSIONAL AND TECHNICAL MANPOWER**

Section I - CURRENT EMPLOYMENT

In this section we are interested in finding out about your work, the people you work with, and your attitudes toward work.

A. YOUR WORK STATUS

1. What were you doing last week? *(Check one)*

1 ☐ Working full time
2 ☐ Working part time
3 ☐ With a job but not at work (on vacation, sick leave, etc.)
(Skip to Question 3)

4 ☐ Not employed, but looking for work
5 ☐ Not in labor force (retired, housewife, student, etc.)
(Go to Question 2)

2. If you were not working last week, when did you last work?
(Answer and go to Section II beginning on Page 4.) →

Month	Year

OR 0 ☐ Never worked *(Skip to Page 6, Section III)*

ANSWER QUESTIONS 3 – 7 IN TERMS OF YOUR MAJOR CURRENT EMPLOYMENT ONLY

DO NOT WRITE HERE

3. YOUR JOB OR BUSINESS

a. For whom did you work last week? *(Name of company, business, organization or other employer.)*

b. In what kind of business, industry, or organization were you working? (For example: city hospital, state university, road construction firm, county junior high school.)

c. Were you working - - *(Check one)*

1 ☐ **For a PRIVATE employer for wages, salary, commission or tips?**
2 ☐ **For GOVERNMENT?** (Federal, State, local, public school system, etc.)
(Go to Question d)

3 ☐ **In OWN business or profession or farm for profit or fees?**
4 ☐ **WITHOUT PAY on family farm or business?**
(Skip to Question e)

d. What is your current yearly salary rate? *(Omit cents)* .... Salary rate $ .00

e. What kind of work were you doing? (For example: civil engineer, nuclear physicist, professor of economics, 9th grade social studies teacher.)

f. In what field of specialization was this? *(Fill in the code number from the enclosed list which best describes your field.)* Code

g. If you were working in a subspecialty within this field, what was it called?

h. Describe what you did in your job. (For example: "Designer of electronic mechanisms in the industrial instrument industry; supervise six other engineers whom I have hired for my unit; prepare reports on the work of my unit.")

i. What was the formal title of your job?

4. How many hours a week do you work in this job or business? .... Hours per week

5. How many years have you been working in this company, business or organization? .... No. of years

OR 0 ☐ Less than one year

(Section I continued)

6. How many weeks did you work in 1961 at all jobs either full-time or part-time?
(Count paid vacation, paid sick leave, and military service as weeks worked.) (Check one)

1 ☐ 13 weeks or less
2 ☐ 14 to 26
3 ☐ 27 to 39
4 ☐ 40 to 47
5 ☐ 48 to 49
6 ☐ 50 to 52
OR 0 ☐ Did not work in 1961

7. YOUR EARNINGS IN 1961:

a. How much did you earn in 1961 in salary and commissions from your major position (before taxes and other deductions)? If you did not work the entire year at this job, give what would have been your yearly salary.

OR--IF YOU ARE SELF-EMPLOYED:

How much did you earn in 1961 in profits or fees from working in your own business, professional practice or partnership (net income after business expenses)?

$ .00
(Estimate to the nearest hundred dollars) (Omit cen

OR 0 ☐ None

b. In addition to your major position, did you receive any earnings in 1961 from any of the following sources?
(Check as many as apply)

1 ☐ Consulting
2 ☐ Publications
3 ☐ Lectures
4 ☐ Other professional activities
5 ☐ Other secondary job

Estimate to the nearest hundred dollars the amount you received from all of these sources in 1961 (before taxes and other deductions but after deducting any business expenses.)

$ .00
(Omit cents)

OR 0 ☐ None

B. YOUR ACTIVITIES

8. Here is a list of activities which may be part of your work in your major current position.
(Please check all activities which you perform in this position.)

Code No.
01 ☐ Teach courses
02 ☐ Recruit, train people in the organization
03 ☐ Engage in basic research
04 ☐ Engage in applied research, or product development
05 ☐ Administering or supervising research or development
06 ☐ Consult or advise clients or customers on technical matters
07 ☐ Make drawings, blueprints, models
08 ☐ Make forecasts, estimate markets
09 ☐ Exploration; or field work
10 ☐ Design or modify equipment, machinery, processes of production
11 ☐ Supervise the work of assistants or subordinates
12 ☐ Quality control; set precision standards
13 ☐ Public relations, publicity work, speeches
14 ☐ Budgeting, costing, controlling, allocating expenditures
15 ☐ Test new or experimental equipment

Code No.
16 ☐ Travel
17 ☐ Constructing equipment, apparatus, prosthetic devices
18 ☐ Treating patients
19 ☐ Counselling clients, students
20 ☐ Supervising production or construction
21 ☐ Writing technical and general reports on projects
22 ☐ Coordinating activities of professionals at my level in the organization
23 ☐ Keep records
24 ☐ Statistical analysis
25 ☐ Technical sales
26 ☐ Negotiating contracts or raising funds
27 ☐ Briefing superiors on my work
28 ☐ Plan future operations
29 ☐ Compile and annotate bibliography; search and select literature
30 ☐ Other. **What?** ________________

9. Of all those you checked above, which TWO do you spend the most time doing?
(Fill in their code numbers and write in the approximate percent of total time spent in each of these activities.)

Activity	Code number	Percen of time
FIRST		
SECOND		

(Section I continued)

C. PEOPLE YOU WORK WITH

10. About how many people work in the smallest organizational unit to which you belong in the business, industry, or organization in which you work?
Elementary and secondary teachers: check the number of teachers in your *school*. *(Check one)*

1 ☐ Less than 10
2 ☐ 10 to 24
3 ☐ 25 to 49
4 ☐ 50 to 99
5 ☐ 100 to 249
6 ☐ 250 to 499
7 ☐ 500 or more

11. How many employees are DIRECTLY responsible to you? *(Include both professional and nonprofessional.)*

Number of people

OR 0 ☐ None

12. Are you - - *(Check one)*

1 ☐ An administrator (concerned mainly with policy making, planning, overall supervision)
2 ☐ A supervisor (concerned mainly with technical matters)
3 ☐ A coordinator (concerned mainly with liaison)
4 ☐ Other. **What?**____________________

13a. Do you - - *(Check as many as apply)*

Code No.
1 ☐ Work with other specialists in your field
2 ☐ Work individually, with little or no consultation with others
3 ☐ Work as an individual consultant to others

Code No.
4 ☐ Work as a member of a team made up of specialists from your field and other fields
5 ☐ Work as a member of a team made up of specialists in other fields
6 ☐ Other. **What?** ____________________

b. Of all those you checked above, which ONE do you spend the most time doing? *(Write in the box the code number from 13a)*

Code

14. This question is about your immediate supervisor.

If you have no immediate supervisor, check here and skip to Question 15. ☐ 0

DO NOT WRITE HERE

a. What kind of work does he do? (For example: civil engineer, nuclear physicist, professor of economics, junior high school principal.)

b. In what field of specialization does he work? *(Fill in the code number from the enclosed list.)*

Code

D. ATTITUDES TOWARD WORK

15. Listed below are some characteristics which occupations may have.

a. Please indicate by checking the appropriate box how important each one is to you.

b. Also check the appropriate box to indicate how well your current major employment satisfies you with respect to each characteristic.

Occupational Characteristics		a. Importance to you			b. Degree of satisfaction		
		Very (1)	Somewhat (2)	Little or none (3)	Very (4)	Somewhat (5)	Little or none (6)
Opportunity to be original and creative	1						
Opportunity to be helpful to others or useful to society	2						
Relative independence in doing my work	3						
A chance to exercise leadership	4						
A nice community or area in which to live	5						
Opportunity to work with things	6						
Social standing and prestige in my community	7						
A chance to earn enough money to live comfortably	8						
Pleasant people to work with	9						
Freedom from pressures to conform in my personal life	10						
Opportunity to work with people	11						
Freedom to select areas of research	12						
Opportunity to work with ideas	13						

(Section I continued)

E. CURRENT ADDITIONAL JOB OR BUSINESS

(Defined as a job not with your primary employer)

DO N
WRIT
HERE

16. Did you have a second regular job or business last week? *(Exclude any work with your major current employer.)*

1 ☐ Yes   2 ☐ No *(Skip to Section II)*

17. In your second regular job or business:

a. What kind of business or industry were you working in?
(For example: city hospital, state university, road construction firm, retail drug store.)

b. Were you working - - *(Check one)*

1 ☐ **For a PRIVATE employer for wages, salary, commission or tips?**

2 ☐ **For GOVERNMENT?** (Federal, State, local, public school system, etc.)

3 ☐ **In OWN business or profession or farm for profit or fees?**

4 ☐ **WITHOUT PAY on family farm or business?**

c. What kind of work were you doing?
(For example: medical technician, research assistant inchemistry, civil engineer, sales clerk.)

d. In what field of specialization did you work? *(Fill in the code number which best describes your field from the enclosed list.)*   Code

18a. Does your additional job involve - - *(Check one)*

1 ☐ Year-round employment   2 ☐ Seasonal employment only

b. How many hours a week do you usually work in this job or business?   Hours per week

Section II - PAST EMPLOYMENT

In this section we are interested in your past work history, especially your work situation in April 1960 (when the Decennial Census was taken) and your first full-time job after reaching age 24.

A. APRIL 1960

DO NO
WRITE
HERE

1. What were you doing in April 1960? *(Check one)*

1 ☐ Working (include part-time work)

2 ☐ With a job but not at work (on vacation, sick leave, etc.)

3 ☐ Looking for work *(Skip to Question 7 on Page 5)*

4 ☐ Not in labor force, e.g., retired, keeping house, student, etc. *(Skip to Question 7 on Page 5)*

2. Were you working for the same company, business, or organization in April 1960 as you were in your major employment last week (including self employment)?

1 ☐ Yes *(Skip to Question 3)*   2 ☐ No *(Please answer Questions a to d)*

a. For whom did you work in April 1960? *(Name of company, business, organization or other employer)*

b. What kind of business or industry were you working in?
(For example: city hospital, state university, road construction firm, county junior high school.)   Kind of business

c. Were you working - - *(Check one)*

1 ☐ **For a PRIVATE employer for wages, salary, commission or tips?**

2 ☐ **For GOVERNMENT?** (Federal, State, local, public school system, etc.)

3 ☐ **In OWN business or profession or farm for profit or fees?**

4 ☐ **WITHOUT PAY on family farm or business?**

d. How many years did you work in this company, business or organization?   No. of years

3. In April 1960, were you doing the same kind of work as you described for last week on Page 1, Item 3e?

1 ☐ Yes *(Skip to next question)*

2 ☐ No (Please describe what kind of work you were doing. For example: civil engineer, nuclear physicist, professor of economics, 9th grade social studies teacher.) →

(Section II continued)

4a. In April 1960, were you working in the same field of specialization as you were last week?

1 ☐ Yes *(Skip to Question 5)*   2 ☐ No *(Go to 4b)*

DO NOT WRITE HERE

b. What field of specialization was this? *(Fill in the code number which best describes your field from the enclosed list.)*   Code

5. In April 1960, which two activities did you spend the most time doing? *(Consult the list on Page 2, Item 8, and fill in the code numbers.)*   First activity   Second activity

6. Your immediate supervisor in April 1960--   If you have no immediate supervisor check here ☐ 0 and skip to Question 7.

What kind of work did he do? (For example: civil engineer, nuclear physicist, professor of economics, junior high school principal.)   Kind of work

B. PLEASE THINK BACK TO THE FULL-TIME CIVILIAN JOB HELD UPON REACHING AGE 24 OR IF NOT WORKING THEN--THE FIRST ONE HELD THEREAFTER.

0 ☐ Check here and skip to Question 11 if you are now under age 24.

7. Was your first full-time civilian job after reaching age 24--

a. The same as in April 1960?.................... 1 ☐ Yes   2 ☐ No

b. The same as your job last week? .... 1 ☐ Yes   2 ☐ No

(If you answered "No" in BOTH "a" and "b", please complete this section. Otherwise skip to Question 11.)

DO NOT WRITE HERE

8. In what year did you enter this job (the job held upon reaching age 24 or the first one held thereafter)?   Year

9a. What kind of business, industry, or organization were you working in? (For example: city hospital, state university, road construction firm, county junior high school.)   Kind of business

b. Were you working at that time -- *(Check one)*

1 ☐ **For a PRIVATE employer for wages, salary, commission or tips?**

2 ☐ **For GOVERNMENT?** (Federal, State, local, public school system, etc.)

3 ☐ **In OWN business or profession or farm for profit or fees?**

4 ☐ **WITHOUT PAY on family farm or business?**

c. What kind of work were you doing? (For example: civil engineer, nuclear physicist, professor of economics, 9th grade social studies teacher.)   Kind of work

d. In what field of specialization was this? *(Fill in the code number which best describes your field from the enclosed list.)*   Code

e. Describe what you did in your full-time job at that time:

____

____

10. How many years did you work in this company, business, or organization?   No. of years

C. GENERAL EMPLOYMENT

11. How many years have you ever worked either full-time or part-time in your present field of specialization?   No. of years

12. How many different employers have you ever had in your present field of specialization?   No. of employers

13. Are there any other fields of specialization in which you worked for at least one year besides those you have already listed? *(Fill in their code numbers from the enclosed list.)*

Field	Code
FIRST	
SECOND	

14. Did you ever work full-time for at least six months in any of the following? *(Check as many as apply)*

01 ☐ Federal Government (includes all civilian employees of Federal Government agencies; also Federal hospitals. Does not include military service.)
02 ☐ State or local government (includes state or municipal hospitals, but excludes public schools or universities)
03 ☐ Public college or university
04 ☐ Private college or university
05 ☐ Public elementary or secondary school
06 ☐ Private elementary or secondary school
07 ☐ Research organization or institute (except government or university)
08 ☐ Hospital, clinic, welfare organization (except government)
09 ☐ Professional partnership
10 ☐ Other private business or industry
11 ☐ Independent consulting work
12 ☐ Other self-employment
13 ☐ Foreign government or international agency
14 ☐ Career in Armed Forces
15 ☐ Other (not mentioned) *(Specify)*

____

Section III - YOUR TRAINING

1. How many years of education and formal training have you had? *(Check the highest year completed)*

Never attended school.................................... 0 ☐

Elementary and high school .... 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐

All schools attended beyond the high school level, including college, technical institute, etc. (academic years)........... 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more ☐

2. Which of the following types of elementary and high schools did you attend? *(Check as many as apply)*

1 ☐ Public 2 ☐ Parochial 3 ☐ Other private

3. While you attended high school, did you receive any G.I. Bill or Vocational Rehabilitation financial aid from the U.S. Veterans Administration?

1 ☐ Yes 2 ☐ No 3 ☐ Never attended high school *(Skip to 6)*

4. During your senior year in high school, was your curriculum - - *(Check one)*

1 ☐ Academic
2 ☐ General
3 ☐ Technical
4 ☐ Vocational
5 ☐ Commercial
6 ☐ Other *(Specify)* ______________________
7 ☐ Did not attend through senior year *(Skip to 6)*

5. How large was your high school graduating class? *(Check one)*

1 ☐ Less than 50
2 ☐ 50 to 99
3 ☐ 100 to 199
4 ☐ 200 to 299
5 ☐ 300 to 399
6 ☐ 400 to 499
7 ☐ 500 or more
8 ☐ Did not graduate

6. List below in order of attendance, each institution from which you obtained or are currently obtaining formal training beyond the high school level, and give the other information as requested.

NOTE: If training was taken abroad, enter the name of the foreign country under "Location".

Use a separate line for each degree granted, worked for, or for any change in major field of specialized study. Refer to the enclosed list for the code numbers of fields of specialized study.

Institution		Major field of study *(Code)*	Year work ended	Type of degree granted (if any)	No. of months of study complet		
Name	Location *(State)*				Total number of months	With G.I. Bill or Voc. Rehab. aid from VA	
						Yes *(No. of months)*	No *(Check)*
1.			19___				
2.			19___				
3.			19___				
4.			19___				

7. How did you finance this post-high school training? *(Check as many as apply)*

Source		Undergraduate (1)	Graduate or professional (2)
A scholarship or fellowship* from:			
College or university............................	01	☐	☐
Federal agency:			
National Science Foundation..............................	02	☐	☐
Public Health Service - National Institutes of Health............	03	☐	☐
Office of Education..............................	04	☐	☐
Other *(Specify)* ______________________	05	☐	☐
A research or teaching assistantship	06	☐	☐
Loans..	07	☐	☐
Own earnings from employment while attending school (except assistantship)	08	☐	☐
Own savings from previous employment (including that earned between school terms).	09	☐	☐
Employer paid for the training	10	☐	☐
Aid from my parents, relatives, spouse, or spouse's parents	11	☐	☐
Veterans Administration Benefits: G.I. Bill or Vocational Rehabilitation..................	12	☐	☐
Other sources	13	☐	☐
(WRITE IN THE BLANKS THE CODE NUMBER OF THE SINGLE MOST IMPORTANT SOURCE.)		______	______

* Defined as a financial grant for which no services are required; does not include loans which require repayment.

(Section III continued)

8. Which of the following items listed below contributed most significantly to your becoming qualified for your present job? *(Check as many as apply)*

V ☐ Check here if you are not currently employed
1 ☐ Experience in present or related field of employment
2 ☐ Course work at a college or university without a degree
3 ☐ Acquired a B.A., B.Sc., etc.
4 ☐ Acquired a graduate or professional degree
5 ☐ Course work at a technical institute
6 ☐ Course work at Junior or Community College
7 ☐ Post-high school courses at a vocational or technical high school
8 ☐ Correspondence courses
9 ☐ Special training or course given by employer
0 ☐ Other *(Please specify)* ____________________

9. Do the qualifications for your present job require a license or a certificate?
1 ☐ Yes
2 ☐ No *(Skip to Question 11)*

10a. Do you presently have such a license or certificate?
1 ☐ Yes
2 ☐ No *(Skip to Question 11)*

b. Is this a standard license or certificate representing full qualifications?
1 ☐ Yes
2 ☐ No

11. Have you ever received or are you currently receiving any of the following types of training?

1 ☐ Yes
2 ☐ No *(Skip to Question 12)*

Code No.		Code No.	
01	Apprenticeships	06	Home study correspondence courses
02	Company training programs (other than apprenticeships)	07	Agricultural training courses
03	Military training applicable to civilian occupations	08	United States Armed Forces Institute courses
04	On-the-job training	09	Work-Study Programs
05	High school extension courses	10	Workshops, Seminars, etc.

(If "Yes," give the name of the organization or institution providing this training received and enter the other information as requested. Do not repeat the training listed in Question 6, Page 6.)

Name of sponsoring institution or organization	Type of training *(Code No. from above list)*	Subject of training	Weeks of training	Year ended	Did you complete the course?		With G.I. Bill or Voc. Rehab. aid from VA	
					Yes	No	Yes	No
				19____				
				19____				
				19____				
				19____				
				19____				
				19____				

12. This question is for United States Veterans of World War II or the Korean Conflict.
☐ Not a veteran of either *(Check here and go to Section IV)*

a. Did you receive any formal vocational counseling, including aptitude testing, from - - *(Check one)*

1 ☐ Veterans Administration or VA Guidance Center
2 ☐ A source other than VA
3 ☐ Both VA and other source
(Please answer "b")

4 ☐ Never had any such vocational counseling *(Please skip to Section IV)*

b. Was this counseling significantly useful to your career?
1 ☐ Yes
2 ☐ No

Section IV - BACKGROUND INFORMATION

In order to aid us in interpreting the information elsewhere in the questionnaire, we need now to know something about your bacl ground and personal characteristics.

1. Age (at last birthday) . . . . Years

2. Sex 1 ☐ Male 2 ☐ Female

3. Citizenship: *(Check one)*
1 ☐ Citizen of the United States
2 ☐ Not a citizen of the United States but have taken out first citizenship papers
3 ☐ Not a citizen of the United States and have not taken out papers for citizenship

4. Where is your residence? . . . . State County

5. Where did you grow up? *(Where did you live most of the time before age 16?)*
1 ☐ In a large city (100,000 population or more)
2 ☐ In a suburb near a large city
3 ☐ In a small or middle-sized city or town (under 100,000 population) but not in a suburb of a large city
4 ☐ Open country (not on a farm)
5 ☐ On a farm

DO NO WRITI HERE

6. What kind of work did your father do when you were about 16 years old?
(For example: 8th grade English teacher, paint sprayer, farm hand, civil engineer.)

7. How many people (including your spouse, children or other relatives, as applicable) are now financially dependent upon you? Number of people

8a. What is your present marital status?
1 ☐ Never married *(Skip to Question 9)*
2 ☐ Married
3 ☐ Separated or divorced
4 ☐ Widowed

b. How many children do you have?
(Enter the number in the appropriate spaces.)

If none, check here . . . . 0 ☐

Children	Boys	Girl:
1. Under 5 years		
2. 5 through 10 years		
3. 11 through 18 years		
4. Over 18 years		

9. Are you currently a member of any professional society or association?
(For example: American Physiological Society, Michigan Engineering Society, New Orleans Academy of Sciences.)
1 ☐ Yes 2 ☐ No *(Go to Question 10)*
Please list the names of all these organizations.

10. Have you published any professional articles or books OR have you delivered any papers at professional meetings?
1 ☐ Yes 2 ☐ No

Please use this space to further explain any of the preceding answers.

FOR CENSUS USE ONLY	A.	B.	C.

FORM 1-56 (5-1-62)

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APPENDIX 2

THE POSTCENSAL STUDY-DATA COLLECTION PROCESSING AND TABULATING[1]

by

Stanley Greene and David L. Kaplan
Bureau of the Census

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THE POSTCENSAL STUDY - DATA COLLECTION, PROCESSING AND TABULATING

Stanley Greene and David L. Kaplan, Bureau of the Census *

The Postcensal Study of Professional and Technical Manpower represents a major survey undertaking of the Bureau of the Census. There were various tasks involved covering a wide range of technical activities.

The major tasks associated with this project presently completed by the Bureau of the Census are as follows:

1. Design and printing of questionnaires and other forms.
2. A pretest covering 600 cases.
3. Sample selection of some 70,000 persons covering 45 specified professional and technical occupations and college-graduate groups from the 1960 Census of Population records.
4. Matching of selected sample cases to the 1960 Population Census schedules to obtain name and address for mailing purposes.
5. Mailing operation consisting of an original mail-out, follow-up as required by two reminder letters and, finally, a reminder letter under the National Science Foundation letterhead.
6. Independent subsampling of the two classes of nonresponses—(1) those returned by the post office as nondeliverable, and (2) those apparently delivered but not answered. The two groups were subsampled for further follow-up by, respectively, (1) addressing new questionnaires to the "postal rejects" in care of their employers (requiring a search and match of the 1960 Census of Population returns for "names of employers" and a directory search for the corresponding address) and (2) having the "nonanswer" cases telephoned by Census Bureau enumerators in the areas covered by the Current Population Survey.
7. Manual editing and coding of the returned questionnaires.
8. Card punching the information (requiring six punch cards per case).

The following phases of the project remain to be implemented although much of the planning work has been completed:

1. Transfer of punch card data to computer tape.
2. Preparation of the computer tape record for each case and weighting of same.
3. Tallying the required tabulations.

Details of the various phases of the planning, implementation, and results are discussed in this paper.

Universe

Several major classes of people comprised the universe included in the survey. The largest class consisted of persons who were reported as being in the experienced civilian labor force in specified professional occupations in the 1960 Census.[1] This included those who were employed in the specified occupations and those who were unemployed, but whose last job was in one of the selected occupations.

The original planning called for 33 professional occupations. Three of these were dropped [2] before the survey was taken, whereas librarians were limited to those employed in public libraries, and elementary or secondary schools and sampled as separate groups. Thus there were 31 distinct professional categories in the survey. These are listed on table 1.

A second major class included in the survey comprised those persons in the "Experienced civilian labor force" in seven technical occupation groups. The occupations included were designers, draftsmen, surveyors, medical and dental technicians, electrical and electronic technicians, other engineering and physical sciences technicians, and technicians not elsewhere classified.

In addition to the two major classes of occupations listed above, the survey included a sample of persons who had completed four or more years of college. This last major class was subdivided into the following seven groups. The first three groups were in the labor reserve [3] in 1960. The three labor reserve groups covered:

1. Female, ages 20 to 54 years, with experience in one of the selected professional or technical occupations.
2. Other persons with experience in one of the selected professional or technical occupations.
3. All persons in labor reserve with experience in occupations not selected for the survey.

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* The authors wish to acknowledge the assistance of Mr. John Priebe in preparing this paper.

The persons in the "experienced civilian labor force" who were in occupations other than those selected for the survey were subdivided into the following three groups:

1. Managers, officials, and proprietors (not elsewhere classified) who were working in the following industries:

    Agriculture, forestry and fisheries
    Mining
    Construction
    Manufacturing
    Transportation, communications, and other public utilities
    Entertainment and recreation services
    Professional and related services
    Public administration

2. Balance - Females, ages 20 to 54 years

3. All others

The remaining group consists of the remaining noninstitutional population, 20 years old and over not in the Armed Forces.

The complete list of 45 classes and the detailed components are outlined in table 1.

Design and printing of questionnaires and other forms

The original questionnaire was designed by the National Opinion Research Center. This questionnaire was reviewed for feasibility by the Bureau of the Census. These two organizations in consultation with the sponsoring agencies, developed the questionnaire that was used in the Census Bureau pretest.

The questionnaire used in the pretest consisted of eight pages divided into four sections. The first section dealt with current employment, asking questions on their present employment status, and, if working, on the respondent's occupation, industry, earnings, job activities, work attitudes, and the holding and nature of a second job.

The second section asked questions on the employment status as of April 1, 1960 (the date of the Decennial Census) and the respondent's first full-time job after reaching age 25 (an age where most persons had completed their formal education).

Section III inquired about the educational and training level of the respondent. It asked questions on the colleges attended, field of study, type of degree granted and year work was ended. This section also asked about the source of finances for their post-high school training and other types of training they may have received, such as company training programs, home study correspondence courses, and military training applicable to civilian occupations.

The last section requested background information such as age, sex, type of residence when growing up, marital status and number of dependents. An analysis of the results of the pretest questionnaire was the basis for redesigning the questionnaire. Most of the changes were in the format, but some changes were made in the items with several additions being made to the section IV on background information.

Three variations of the questionnaire were designed and used in the survey. The basic questionnaire was used for the selected professional occupations, and the three "experienced civilian labor force" classes. A variation of the basic questionnaire was used for the technicians. The major changes in this questionnaire were in the list of job activities, and the technicians were not asked work attitudes. A second variation of the questionnaire was used for the labor reserve and the last class of those not in the labor force nor the labor reserve. The major difference in this questionnaire was in the method of asking for past work experience.

A supplementary questionnaire was sent to a portion of the biologists and psychologists on sources of research support they may have received during their graduate studies.

Pretests

A feasibility pretest of this survey, covering 275 cases, was conducted in the Chicago area by the National Opinion Research Center. Another pretest was conducted by the Bureau of the Census beginning in the fall of 1961. Persons in professional and technical occupations used in this survey were selected from a special evaluation project file which provided the names and addresses of respondents. Approximately 600 cases were selected for the pretest. An original mailing was followed by two reminder mailings sent to the nonrespondents. The response rates of this pretest are given below.

	Number	Responses	
		Number	Percent
Total..........	591	419	70.9
Original mailing.....	591	254	43.0
First follow-up......	445	116	26.1
Second follow-up.....	229	49	21.4

A subsample of the nonresponse cases, amounting to 51 cases, was drawn for further follow-up activity. This work consisted of a personal phone call reminder to the nonrespondent and produced 23 additional returns. Therefore the final number of completed questionnaires received in the pretest was 442 or 74.8 percent. (A figure quite similar to our results in the main study.)

These completed questionnaires were then analyzed and tabulated focusing on the problem of nonresponse by item and inconsistency between items. The result of this analysis was the final determinant in preparing the format and wording of the questionnaires.

Sample selection

The Bureau, in consultation with the sponsoring agencies, selected the sample for the survey. First, within the limits of financing and statistical reliability, the number of sample cases required for each occupation and other group in the universe was determined. (See col. 1 of table 2.) Estimates were made—since the universe counts were not yet available at the time—of the number of cases of each of these groups that would appear on the 1960 Census 25-percent sample tape file. These two figures provided the basis for determining a differential sampling ratio for each group to supply the required number of sample cases (col. 3). Since the basic universe was not known but had to be estimated, a very liberal sampling ratio was adopted to assure that a sufficient number of sampling cases would be selected from the Census 25-percent sample file. Using these sampling ratios, the first selection (and count of the total in each category) was made by the computer on a sample "every K case" basis. The computer identified and selected by the predetermined sampling ratio each category of the sample universe (shown in col. 4).

Revisions in the groups to be surveyed were also made. For example, pharmacists were deleted from the study and became the basis of a special project.

Such revisions in the groups were cause for increasing the number of sample cases required for certain of the remaining groups (col. 2). The revised number of sample cases required for the study was then compared to the first sample selection based upon the liberal sampling fraction. A division of these two figures for each group provided a subsampling fraction (col. 5). The computer then applied the subsampling fraction to the first sample selection and selected the final sample (col.6). This was accomplished in the following manner. A random start between zero and the final sampling fraction was selected for each category. To this random start the sampling fraction (to five decimal places) was added for each case in the first sample selection. When this sum exceeded or equaled "one" the case thus identified was selected and the sum reduced by one. If the sum for the case did not equal or exceed "one" the case was not selected and the next addition was made.

The computer thus identified the sample cases and also selected for high-speed printouts, pertinent data for the sample case, providing a basis for searching original Census records for purposes of matching and name and address determination for mailing the questionnaires.

A subsample of 1,500 biologists and 1,000 psychologists was selected to receive the supplementary questionnaire on research support. These cases were selected by using a random start and every "n"th case thereafter. "n" was computed by dividing the number of cases selected to receive the supplementary questionnaire by the total number of cases in the survey with the specified occupational code.

Matching and mailing operations

When the sample was selected from the 1960 Census tapes, certain identification items were selected for each case and printed out on a listing. Some of the identification items used were the codes for State, county, enumeration district (ED), occupation, industry, age, and highest school grade completed. Each case was also assigned a control number. With this information the Census schedule books were searched to ascertain the name and address of the individual.

At the same time the names and addresses were being located, punch cards were being prepared for control purposes. These cards noted the control number, State, and a code indicating the type of questionnaire required. The name and address, as ascertained from the match of Census records, was also typed on the card. This typed address was reproduced by a Xerox process and used for the address labels. The card itself was used for check-in control (those not showing a notation of receipt of schedule being sent additional mailings as required).

Although there were 45 independent samples comprising the survey, they broke down into three major components for purposes of schedule design and into four separate groups for purposes of the mailing operation.

The mailing operation consisted of an original mailing and three follow-up mailings. Each mailing—the original and follow-up—was color coded by varying the color of the schedule. This was done primarily for control of the mailout sequence. The mailouts were divided into four groups as determined by the respondents' status in the 1960 Census. The first group represented selected professional workers in the labor force (excluding 2,500 biological scientists and psychologists).

All biological scientists and psychologists were sorted from the professional group described above. A sample of about 1,500 biological scientists and 1,000 psychologists was then merged into one group. The portion of the biological scientists and psychologists not selected in the sample was returned to their original file.

Another group consists of those persons with technical occupations. The last group is composed of the labor reserve.

The mailing pieces to each of these groups consisted of (1) the respective questionnaire, (the biological scientists and psychologists also received a supplementary questionnaire), (2) an introductory letter, (3) a "Fields of Specialization List," (4) a return envelope.

Receipts

The endeavors described in the mailing operation elicited 51,505 completed questionnaires from the original panel of 71,300. The rate of receipt amounted to 72.2 percent. This figure compares favorably with our pretest experience where the return rate amounted to 70.9 percent.

Variations in the categories may be noted in table 1. (This table shows rates of receipt by each of the 45 classes.) For the professional group, the highest receipt rate was achieved, amounting to 72.6 percent, whereas the technical worker group--somewhat under the average return rate--amounted to 63.9 percent. Among the professional workers, it may be noted that the highest return rate is 82 percent (foresters and conservationists).

Field follow-up procedures

About 12,500 of the original cases did not respond to any of the four original mailings and constituted the "nonanswer" file of nonrespondents. This group was sampled at approximately a 1 in 4 rate for personal follow-up. Thus about 3,000 cases required follow-up, all of which, by design, fell into Primary Sampling Units of the Bureau's Current Population Survey and thus an existing field staff was available to implement the procedure. The procedure called for all sample cases to be selected in the Bureau's central office and identified by their PSU number and other relevant information (name, address, phone number, appropriate schedule). This information was packaged along with required forms and instructions and sent to the Bureau's Regional Offices. The Regional Offices in turn transmitted the materials to the proper interviewers. The interviewers contacted each nonrespondent by telephone, asking them to complete a questionnaire. Those cases indicating cooperation were mailed one by the interviewer, along with a Regional Office return envelope. Those cases indicating a refusal to complete a questionnaire were asked eight basic questions on the phone.

When the interviewer completed this phase of the work, she sent a record of the results of her assignment to the Regional Office. The Regional Office matched the completed questionnaires received to the record of results. The unmatched forms for those who were mailed questionnaires were returned to the interviewers, who again called the person and proceeded to ask the basic questions.

In regard to the "postal reject" file (that group never delivered by the post office), amounting to 7,100 cases, a sample of 1,000 random cases was drawn. A further attempt to locate these cases was made through their last known employer. Since the 1960 Census results provided the name of the employer, we had a basis for operation.

The steps required to implement this follow-up required a matching and searching of the original census record. After the case was located, the company name entered on the schedule was transcribed to a special listing. The address of the establishment was then obtained by checking through city directories and other reference material. The questionnaires were then mailed to the respondent in care of his employer using the normal mailing procedures with provision made for the follow-up mailings. These activities resulted in a return rate of about 30 percent.

Coding and editing of schedules

The processing work was accomplished by dividing the work into two major portions, namely "General Coding" and "Occupation and Industry Coding." The schedules were designed to minimize coding by annotating the entry boxes where possible with predetermined punching codes. Where this was not possible, as in the cases of "institution attended," "type of degree granted," "name of sponsoring institution," "subject of training," and "State and county of residence," codes had to be predetermined and, as in the case of "subject of training," a three-digit code was formulated and a special publication prepared noting the subject field content of each broad three-digit field. Also, during the "General Coding" phase, extensive editing rules were applied to the items to account for some blanks, obvious inconsistencies, consideration of fractions, improper placement of entries, dual entries, finding midpoints of ranges (if given), conversion of income entries to codable items, conversion of improper time basis to acceptable basis. Further editing of this nature will also be implemented in the computer.

The "Occupation and Industry Coding" phase of the work was done in accordance with the 1960 Census of Population classification scheme, with some minor modifications. All clerical work was verified completely on a dependent basis.

Preparing the record and weighting

Prior to tallying the tabulations in the Postcensal Study, certain programing activities are required to prepare the computer tape record.

Each questionnaire required six 80-column punch cards to accommodate the data. This information must first be transferred from punch cards to computer tape and the six cards for each case must be consolidated into a single record for a person (eliminating the duplication of identification items required on each punch card).

Each of the 45 occupations receives a differential weight. The methodology involved in this weighting calls for a consideration of the three following classes of responses:

1. Initial responses
2. Responses from a field follow-up program
3. Responses from a file of "postal rejects"

The latter two classes have to be weighted to the totals from which they are drawn.[4] The determination of these weights will be done clerically and incorporated in the punch card. After these intermediate weights are on the record and are applied to the latter two classes, this file will be merged with the initial responses (class 1). The final weights to be applied to each occupation group would be the proportions these merged totals bear to their respective grand total as determined by the 1960 Census results.

FOOTNOTES

[1] For information on the classification of occupations in the 1960 Census, see U.S. Bureau of the Census, 1960 Census of Population, Alphabetical Index of Occupations and Industries, Revised Edition, Washington, D.C., 1960, and its companion volume U.S. Bureau of the Census, 1960 Census of Population, Classified Index of Occupations and Industries, Washington, D.C., 1960. For information on the definition of concepts used by the Bureau of the Census, see the text in the following reports: U.S. Census of Population: 1960, Detailed Characteristics, United States Summary, Final Report PC(1)-1D, Washington, D.C., 1963, and U.S. Census of Population: 1960, Occupational Characteristics, Final Report PC(2)-7A, Washington, D.C., 1963. The second report will be released in October of 1963.

[2] Professional nurses, pharmacists, and physicians and surgeons who were employed by any level of government, but not working in hospitals.

[3] In the 1960 Census the term labor reserve was used for those persons who had worked sometime during the period of 1950 to 1960, but were not in the labor force at the time of the census.

[4] The methodology outlined herein is subject to review of the reliability of the follow-up data by Bureau sampling experts.

Table 1.--DETAILED COMPONENTS OF THE UNIVERSE AND RECEIPTS IN THE POSTCENSAL STUDY OF PROFESSIONAL AND TECHNICAL MANPOWER

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
I. Occupations in the survey and their Census codes	71,300	51,505 1/	72.2 1/
A. Selected professional occupations	56,137	40,768	72.6
021 Chemists	2,500	1,839	73.6
College presidents, deans, and professors and instructors, nonscientific subjects	1,260	905	71.8
030 College presidents and deans			
054 Professors and instructors, nonscientific subjects			
Professors and instructors, natural science	2,501	1,856	74.2
031 Professors and instructors, agricultural sciences			
032 Professors and instructors, biological sciences			
034 Professors and instructors, chemistry			
041 Professors and instructors, geology and geophysics			
042 Professors and instructors, mathematics			
043 Professors and instructors, medical sciences			
045 Professors and instructors, physics			
052 Professors and instructors, natural sciences, not elsewhere classified			
Professors and instructors, social science	1,494	1,155	77.3
035 Professors and instructors, economics			
050 Professors and instructors, psychology			
051 Professors and instructors, statistics			
053 Professors and instructors, social sciences, not elsewhere classified			
040 Professors and instructors, engineering	2,000	1,529	76.5
060 Professors and instructors, subject not specified	1,249	873	69.9
080 Engineers, aeronautical	1,999	1,383	69.2
081 Engineers, chemical	1,270	974	76.7
082 Engineers, civil	1,948	1,354	69.5
083 Engineers, electrical	3,499	2,533	72.4
084 Engineers, industrial	2,000	1,457	72.9
085 Engineers, mechanical	1,999	1,399	70.0
090 Engineers, metallurgical and metallurgists	1,000	726	72.6
091 Engineers, mining	1,000	708	70.8
092 Engineers, sales	1,000	682	68.2
093 Engineers, not elsewhere classified	2,782	1,971	70.8
103 Foresters and conservationists with 4 or more years of college	1,000	820	82.0

1/ Figures include 966 cases received after the tally by occupation, thus detail will not add to total.

Table 1.--DETAILED COMPONENTS OF THE UNIVERSE AND RECEIPTS IN THE POSTCENSAL STUDY OF PROFESSIONAL AND TECHNICAL MANPOWER--Con.

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
111 Librarians - elementary and secondary schools) ..with 4 or more years of college 111 Librarians - public libraries)	1,751	1,335	76.2
130 Agricultural scientists	1,991	1,494	75.0
131 Biological scientists	3,502	2,528	72.2
134 Geologists and geophysicists	2,000	1,351	67.6
135 Mathematicians	1,909	1,321	69.2
140 Physicists	2,295	1,714	74.7
145 Miscellaneous natural scientists	1,022	787	77.0
172 Economists	1,136	805	70.9
173 Psychologists	2,150	1,570	73.0
174 Statisticians and actuaries	1,000	716	71.6
175 Miscellaneous social scientists	878	613	69.8
182 Teachers, elementary schools (Public schools only)	2,999	2,164	72.2
183 Teachers, secondary schools	3,003	2,206	73.5
B. Selected technical occupations	7,999	5,108	63.9
072 Designers	1,000	673	67.3
074 Draftsmen	1,000	701	70.1
181 Surveyors	1,000	587	58.7
185 Technicians, medical and dental	1,000	619	61.9
190 Technicians, electrical and electronic	999	636	63.6
191 Technicians, other engineering and physical sciences	2,000	1,274	63.7
192 Technicians, not elsewhere classified	1,000	618	61.8
II. Persons with an educational attainment of four or more years of college			
A. In experienced civilian labor force and not in the selected professional or technical occupations	2,948	1,903	64.6
1. Managers, officials, and proprietors (not elsewhere classified) who were working in the following industries	943	1,903	64.6
Agriculture, forestry and fisheries			
Mining			
Construction			
Manufacturing			
Transportation, communications, and other public utilities			
Professional and related services			
Public administration			
2. Balance - Females, ages 20 to 54 years) 3. All others)	2,005		
B. Labor reserve	3,313	2,160	65.2
1. Females, ages 20 to 54 years, with experience in one of the selected professional or technical occupations	2,000	1,681	74.2
2. Other persons with experience in one of the selected professional or technical occupations	267		
3. All persons in the labor reserve with experience in occupations not selected for the survey	1,046	479	45.8
C. Persons 20 years old or older not in the labor force, labor reserve nor institutions	903	600	66.4

Table 2.--SAMPLE SELECTION FOR THE POSTCENSAL STUDY OF PROFESSIONAL AND TECHNICAL MANPOWER

Occupation or classification	(1) Original number of sample cases required	(2) Final number of sample cases required	(3) Original liberal sampling fraction	(4) Original sample count	(5) Sub-sampling ratio	(6) Final sample selected
Total in survey	73,000	76,869	-	152,510	-	71,300
Total professional occupations	55,000	59,869	-	90,774	-	56,137
Total college presidents, deans and professors	7,000	8,500	-	11,230	-	8,504
College presidents, deans, and professors and instructors, nonscientific subjects	1,000	1,250	1/4	2,465	0.50710	1,260
Professors and instructors, natural science	2,000	2,500	1/4	2,548	0.98117	2,501
Professors and instructors, social science	1,000	1,500	1/4	2,167	0.69221	1,494
Professors and instructors, engineering	2,000	2,000	1/1	2,359	0.84782	2,000
Professors and instructors, subject not specified	1,000	1,250	1/8	1,691	0.73921	1,249
Total engineers	18,000	20,282	-	32,654	-	18,497
Engineers, aeronautical	1,500	2,000	1/4	3,284	0.60902	1,999
Engineers, chemical	2,000	2,000	1/8	1,270	1.0	1,270
Engineers, civil	2,500	2,500	1/20	1,948	1.0	1,948
Engineers, electrical	2,500	3,500	1/10	4,618	0.75791	3,499
Engineers, industrial	2,000	2,000	1/8	3,095	0.64621	2,000
Engineers, mechanical	2,500	2,500	1/20	1,999	1.0	1,999
Engineers, metallurgical and metallurgist	1,000	1,000	1/2	2,305	0.43384	1,000
Engineers, mining	1,000	1,000	1/2	1,526	0.65531	1,000
Engineers, sales	1,000	1,000	1/2	7,170	0.13948	1,000
Engineers, not elsewhere classified	2,000	2,782	1/4	5,438	0.51159	2,782
Foresters and conservationists (4 years of college)	1,000	1,000	1/1	2,936	0.34060	1,000
Librarians	2,000	2,000	1/4	5,250	4 yrs.college	1,751
Total natural scientists	16,000	16,800	-	19,237	-	15,219
Agricultural scientists	2,000	2,000	1/1	1,991	1.0	1,991
Biological scientists	4,000	4,000	1/1	3,502	1.0	3,502
Chemists	2,000	2,500	1/8	2,617	0.95530	2,500
Geologists and geophysicists	2,000	2,000	1/1	4,695	0.42599	2,000
Mathematicians	2,000	2,000	1/1	1,909	1.0	1,909
Physicists	2,080	2,300	1/1	3,501	0.65696	2,295
Miscellaneous natural scientists	2,000	2,000	1/1	1,022	1.0	1,022

Table 2.--SAMPLE SELECTION FOR THE POSTCENSAL STUDY OF PROFESSIONAL AND TECHNICAL MANPOWER--Con.

Occupation or classification	(1) Original number of sample cases required	(2) Final number of sample cases required	(3) Original liberal sampling fraction	(4) Original sample count	(5) Sub-sampling ratio	(6) Final sample selected
Total social scientists	5,000	5,287	-	10,080	-	5,164
Economists	1,000	1,137	1/1	4,814	0.23619	1,136
Psychologists	2,000	2,150	1/1	3,014	0.71334	2,150
Statisticians and actuaries	1,000	1,000	1/4	1,373	0.72834	1,000
Miscellaneous social scientists	1,000	1,000	1/1	879	1.0	878
Teachers, elementary public schools	3,000	3,000	1/50	4,197	0.71480	2,999
Teachers, secondary schools	3,000	3,000	1/25	5,190	0.57804	3,003
Total technicians	7,000	8,000	-	32,934	-	7,999
Designers	1,000	1,000	1/10	1,672	0.59809	1,000
Draftsmen	1,000	1,000	1/50	1,061	0.94251	1,000
Surveyors	1,000	1,000	1/5	2,291	0.43650	1,000
Technicians, medical and dental	1,000	1,000	1/20	1,734	0.57671	1,000
Technicians, electrical and electronic	1,000	1,000	1/1	23,176	0.04315	999
Technicians, other engineering and physical science	1,000	2,000	1/10	4,684	0.42699	2,000
Technicians, not elsewhere classified	1,000	1,000	1/5	3,340	0.29941	1,000
Persons in "Other" groups with 4 years of college	11,000	9,000	-	23,778	-	7,164
Experienced civilian labor force not in target occupations	3,000	3,000	-	16,522	-	2,948
Selected managers	1,000	1,000	1/100	943	1.0	943
Balance females ages 20 to 54	1,000	1,000	1/20	8,207	0.10309)	2,005
All others	1,000	1,000	1/100	7,373	0.13211)	
Labor reserve	5,000	4,000	-	6,353	-	3,313
Females ages 20 to 54 in target occupations	4,000	2,000	1/25	2,950	0.67797	2,000
All others in target occupations	1,000	1,000	1/100	267	1.0	267
Not in target occupations	-	1,000	-	3,136	0.33333	1,046
Persons 20 years old or over not in the labor force, labor reserve nor institutions	2,000	2,000	1/200	903	1.0	903

APPENDIX 3

ADDITIONAL FIELD OF SPECIALIZED STUDY TABULATIONS: 1962 GROUP

TABLE A-3.1

FIELD OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE (1962) BY OCCUPATION GROUP (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Elementary School Teaching	Secondary School Teaching	Education	Engineering	Mathematics and Statistics	Physics	Chemistry	Other Physical Sciences	Biological Sciences	Agricultural Sciences	Health Fields	Psychology	Social Sciences (Other)	Humanities	Technical Specialties	Other	Weighted Number of Persons
Engineers	0	1	1	82	2	2	2	1	0	1	1	0	1	1	0	5	469,017
Physical scientists . . .	0	2	2	8	2	12	48	16	3	1	2	0	1	1	0	1	98,337
Biological scientists . . .	0	2	2	2	0	0	4	1	56	25	4	1	2	0	0	1	25,496
Mathematicians . .	1	5	4	4	56	3	2	1	1	1	1	2	9	2	0	10	23,987
Social scientists.	1	2	8	2	1	0	1	1	1	2	1	24	34	3	0	21	53,002

N	669,839
NA, field	49,032
NA, other	848
No degree	434,788
Total N	1,154,507

TABLE A-3.2

FIELD OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE (1962) BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Educational Attainment (1962)	Elementary School Teaching	Secondary School Teaching	Education	Engineering	Mathematics and Statistics	Physics	Chemistry	Other Physical Sciences	Biological Sciences	Agricultural Sciences	Health Fields	Psychology	Social Sciences (Other)	Humanities	Technical Specialties	Other	Weighted Number of Persons
Engineers	Bachelor's . .	0	1	1	86	1	2	2	1	0	1	0	0	1	0	0	4	247,228
	Bachelor's plus	0	1	1	80	2	3	3	1	0	1	1	0	2	1	1	5	135,878
	Master's . . .	0	2	2	74	3	3	2	2	0	1	1	1	1	1	0	8	64,819
	Doctorate . . .	0	0	2	68	3	7	6	4	0	0	1	1	0	3	1	4	9,203
Physical scientists	Bachelor's . .	0	1	2	11	2	5	53	16	3	1	1	0	1	1	1	2	29,629
	Bachelor's plus	1	2	1	11	4	10	43	15	4	2	3	0	1	2	0	2	23,691
	Master's . . .	0	3	2	7	2	16	40	21	3	1	1	0	1	1	0	2	21,934
	Doctorate . . .	0	0	1	2	0	22	57	11	3	1	1	0	1	1	0	0	22,009
Biological scientists	Bachelor's . .	0	3	1	2	0	0	5	1	38	41	5	1	3	0	1	2	4,969
	Bachelor's plus	0	2	2	2	1	1	8	2	42	26	9	1	1	2	0	3	3,475
	Master's . . .	1	3	2	2	0	0	2	1	52	30	2	3	2	0	0	1	7,185
	Doctorate . . .	0	0	1	1	0	1	4	0	74	14	1	1	2	0	0	1	9,496
Mathematicians	Bachelor's . .	1	6	4	2	49	1	2	1	1	2	0	2	10	2	0	18	6,462
	Bachelor's plus	2	6	1	5	48	5	4	2	1	1	1	2	9	4	0	12	4,870
	Master's . . .	0	4	7	3	58	2	1	1	1	2	1	2	9	3	0	6	8,176
	Doctorate . . .	0	2	4	1	74	4	1	1	2	1	0	3	6	2	0	1	4,132
Social scientists	Bachelor's . .	1	5	2	8	3	0	1	0	0	4	0	5	25	5	0	40	5,433
	Bachelor's plus	1	2	3	7	2	0	1	1	1	1	1	13	32	7	0	29	5,617
	Master's . . .	2	3	11	1	0	0	1	1	2	2	1	22	27	2	0	27	20,240
	Doctorate . . .	1	1	8	0	1	0	1	0	1	1	0	34	43	2	0	7	21,397

N	655,843
NA, other . . .	47,317
No degree . . .	451,347
Total N . . .	1,154,507

TABLE A-3.3

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED BY 1962 OF WORKERS IN FIVE OCCUPATION GROUPS (1960), BY FIELD OF STUDY

(Cumulative Percentage Distribution)

Occupation Groups (1960)	Selected Fields of Specialized Study	Cumulative Per Cent				Weighted Number of Persons
		Bachelor's	Bachelor's Plus	Master's	Doctorate	
Engineers	Engineering .	100	43	14	2	375,439
	Other	100	58	24	4	81,689
Physical scientists	Engineering .	100	58	24	5	7,679
	Physics . . .	100	88	68	40	12,226
	Chemistry . .	100	67	45	27	46,925
	Other physical sciences . .	100	69	46	16	15,669
	Other	100	70	37	12	14,764
Biological scientists	Biological sciences . .	100	87	76	50	14,152
	Agriculture .	100	68	54	21	6,387
	Other.	100	76	52	24	4,559
Mathematicians	Mathematics and statistics	100	76	59	23	13,273
	Social sciences	100	69	48	14	2,561
	Other	100	68	42	10	7,806
Social scientists	Education . .	100	97	94	42	4,169
	Psychology . .	100	99	94	44	16,797
	Other social sciences . .	100	92	82	51	17,851
	Other.	100	79	63	18	18,039

N	659,985
NA, other	48,165
No degree	446,357
Total N	1,154,507

TABLE A-3.4

OCCUPATION GROUP (1960), EDUCATIONAL ATTAINMENT (1962), AND SEX

a) Per Cent Whose Field of Study for Highest Academic Degree Differed from 1960 Occupation Group

(Percentage Distribution)

Occupation Group (1960)	Bachelor's		Bachelor's Plus		Master's		Doctorate	
	Men	Women	Men	Women	Men	Women	Men	Women
Physical scientists .	26 (27,088)	19 (2,541)	31 (22,093)	23 (1,598)	24 (20,360)	22 (1,574)	10 (21,375)	14 (634)
Biological scientists	18 (3,781)	33 (1,188)	28 (2,773)	48 (702)	16 (6,131)	30 (1,054)	12 (8,875)	9 (621)
Mathematicians	53 (4,252)	46 (2,210)	52 (3,940)	53 (930)	41 (6,787)	48 (1,389)	26 (3,877)	35 (255)
Social scientists . .	70 (3,577)	70 (1,856)	56 (4,487)	50 (1,130)	46 (14,211)	62 (6,029)	23 (18,300)	26 (3,097)

N	198,715
NA, other	19,532
Degree exclusions . .	56,518
Total N	274,765

TABLE A-3.4--Continued

b) Per Cent Whose Field of Study for Highest Academic Degree Was the Same as 1960 Occupation Group

(Percentage Distribution)

Occupation Group (1960)	Field of Specialized Study	Bachelor's		Bachelor's Plus		Master's		Doctorate	
		Men	Women	Men	Women	Men	Women	Men	Women
Physical scientists	Chemistry . .	51	73	41	72	38	62	56	62
	Physics . . .	5	4	11	2	16	7	23	13
	Other physical sciences . .	18	4	17	3	22	9	11	11
	Total . . .	74 (27,088)	81 (2,541)	69 (22,093)	77 (1,598)	76 (20,360)	78 (1,574)	90 (21,375)	86 (634)
Biological scientists	Biology . . .	28	67	40	52	49	69	73	91
	Agriculture .	54	0	32	0	35	1	15	0
	Total . . .	82 (3,781)	67 (1,188)	72 (2,773)	52 (702)	84 (6,131)	70 (1,054)	88 (8,875)	91 (621)
Mathematicians	Mathematics .	47 (4,252)	54 (2,210)	48 (3,940)	47 (930)	59 (6,787)	52 (1,389)	74 (3,877)	65 (255)
Social scientists	Psychology . .	3	8	12	17	21	24	32	46
	Other social sciences . .	27	22	32	33	33	14	45	28
	Total . . .	30 (3,577)	30 (1,856)	44 (4,487)	50 (1,130)	54 (14,211)	38 (6,029)	77 (18,300)	74 (3,097)

N	175,075
NA, other	19,425
Degree exclusions . .	80,265
Total N	274,765

TABLE A-3.5

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED FOR SELECTED FIELDS OF SPECIALIZED STUDY BY EDUCATIONAL ATTAINMENT (1962), SEX, AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960)	Field of Specialized Study	Sex	Cumulative Per Cent			Weighted Number of Persons
			Bachelor's Plus*	Master's	Doctorate	
Physical scientists	Chemistry . .	Men	68	46	28	42,545
		Women	58	31	9	4,380
	Other physical sciences . .	Men	77	55	27	27,225
		Women	72	61	23	670
	Other fields .	Men	66	33	10	21,146
		Women	62	33	7	1,297
Biological scientists	Biological sciences and agriculture .	Men	83	72	44	15,186
		Women	67	52	22	2,425
	Other fields .	Men	81	63	33	6,374
		Women	65	36	7	1,140
Mathematicians	Mathematics .	Men	81	64	27	10,763
		Women	53	35	7	2,510
	Other fields .	Men	72	46	12	8,093
		Women	55	33	4	2,274
Social scientists	Psychology . .	Men	99	93	62	9,426
		Women	96	90	45	3,202
	Other social sciences . .	Men	94	85	54	15,327
		Women	84	69	35	2,524
	Other fields .	Men	84	68	26	15,822
		Women	79	71	12	6,386

N	198,715
Degree exclusions . .	56,625
NA, other	19,425
Total scientists .	274,765

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*Percentages refer to those entering graduate school among those who have received the bachelor's.

TABLE A-3.6

SELECTED FIELDS OF SPECIALIZED STUDY FOR HIGHEST ACADEMIC DEGREE, BY EDUCATIONAL ATTAINMENT (1962), AGE (1962), AND OCCUPATION GROUP (1960)

(Per Cent in Each Field of Specialized Study)

Occupation Group (1960)	Field of Specialized Study	Bachelor's			Bachelor's Plus			Master's			Doctorate		
		25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54
Engineers	Engineering .	87	87	82	81	80	74	76	75	61	77	80	41
	Other fields .	13	13	18	19	20	26	24	25	39	23	20	59
	Total N . .	85,536	100,790	33,081	50,340	53,588	19,996	25,114	24,991	8,380	2,878	4,168	1,272
Physical scientists	Chemistry . .	54	47	67	46	39	46	36	42	37	51	56	65
	Other physical sciences . .	15	23	9	15	19	12	25	23	17	14	9	11
	Other fields .	31	30	24	39	42	42	29	35	46	35	35	24
	Total N . .	11,273	10,912	4,048	9,250	8,768	3,560	8,119	7,872	3,351	5,756	9,816	3,707
Biological scientists	Biological sciences . .	44	37	22	48	38	37	61	45	52	72	75	76
	Agriculture .	35	46	58	23	30	30	25	33	28	14	16	13
	Other fields .	21	17	20	29	32	33	14	22	20	14	9	11
	Total N . .	1,784	1,765	698	1,229	1,037	781	2,442	2,487	1,257	2,144	4,196	1,814
Mathematicians	Mathematics .	60	39	26	61	43	41	63	57	53	81	71	72
	Other fields .	40	61	74	39	57	59	37	43	47	19	29	28
	Total N . .	3,132	1,509	747	2,306	1,278	609	3,198	2,426	1,377	1,217	1,423	928
Social scientists	Psychology . .	6	2	4	13	16	8	26	24	14	57	37	25
	Other social sciences . .	29	20	25	37	27	36	31	30	22	32	41	51
	Other fields .	65	78	71	50	57	56	43	46	64	11	22	24
	Total N . .	2,110	1,481	875	1,988	1,610	970	6,669	7,054	3,740	3,554	8,802	5,149

N	582,886
Age and degree exclusions	534,382
NA, other	37,239
Total N	1,154,507

TABLE A-3.7

CUMULATIVE PERCENTAGES FOR HIGHEST ACADEMIC DEGREE ATTAINED IN SELECTED FIELDS OF SPECIALIZED STUDY, BY EDUCATIONAL ATTAINMENT (1962), AGE (1962), AND OCCUPATION GROUP (1960)

(Cumulative Percentage Distribution)

Occupation Group (1960)	Field of Specialized Study	Age	Cumulative Per Cent			Weighted Number of Persons
			Bachelor's Plus*	Master's	Doctorate	
Engineers	Engineering .	25-34	46	16	2	136,221
		35-44	43	15	2	152,714
		45-54	44	13	1	47,841
	Other fields .	25-34	58	24	2	27,647
		35-44	57	23	3	30,823
		45-54	60	26	5	15,416
Physical scientists	Chemistry . .	25-34	62	36	18	16,166
		35-44	70	50	32	17,350
		45-54	66	46	30	7,999
	Other physical sciences . .	25-34	78	54	21	11,027
		35-44	74	54	29	11,530
		45-54	85	65	32	3,143
	Other fields .	25-34	61	29	7	7,205
		35-44	67	32	12	8,494
		45-54	76	39	9	3,524
Biological scientists	Biological sciences . .	25-34	81	67	33	4,149
		35-44	87	79	57	4,742
		45-54	95	81	54	2,210
	Agriculture .	25-34	66	55	23	1,233
		35-44	69	59	32	1,970
		45-54	66	48	20	1,060
	Other fields .	25-34	74	50	22	2,217
		35-44	81	65	31	2,773
		45-54	83	59	31	1,280
Mathematicians	Mathematics .	25-34	70	48	16	6,286
		35-44	83	68	29	3,534
		45-54	90	76	36	1,844
	Other fields .	25-34	65	40	7	3,567
		35-44	71	47	13	3,102
		45-54	69	50	14	1,317

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*Percentages refer to those entering graduate school among those who have received the bachelor's.

TABLE A-3.7--Continued

Occupation Group (1960)	Field of Specialized Study	Age	Cumulative Per Cent			Weighted Number of Persons
			Bachelor's Plus*	Master's	Doctorate	
Social scientists	Psychology . .	25-34	98	94	50	3,871
		35-44	100	96	63	4,714
		45-54	99	98	70	1,609
	Other social sciences . .	25-34	86	70	25	4,476
		35-44	95	89	56	6,341
		45-54	94	86	66	3,964
	Other fields .	25-34	76	58	8	5,974
		35-44	85	72	29	7,892
		45-54	88	76	28	5,161

N	582,886
NA, other	37,239
Age and degree exclusions .	534,382
Total N	1,154,507

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*Percentages refer to those entering graduate school among those who have received the bachelor's.

TABLE A-3.8

PER CENT OF DEGREES IN ALL FIELDS, PER CENT OF DEGREES IN THE SAME FIELDS, AND INDEX OF ACADEMIC CONCENTRATION FOR FIELDS OF SPECIALIZED STUDY FOR ALL DEGREES HELD, BY EDUCATIONAL ATTAINMENT (1962) AND OCCUPATION GROUP (1960)

Educational Attainment (1962)	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
	a) Per Cent All Degrees				
Bachelor's .	98	94	95	96	91
N	259,837	32,236	5,362	7,004	6,129
Bachelor's plus . . .	110	102	102	105	109
N	144,899	24,931	3,716	5,288	6,139
Master's . .	192	185	189	189	187
N	70,055	24,075	7,881	9,014	22,881
Doctorate .	249	235	260	234	254
N	10,056	24,055	10,507	4,790	24,132

	b) Per Cent Same Field of Study and Employment				
Bachelor's .	84	69	74	46	27
Bachelor's plus . . .	85	69	66	47	43
Master's . .	145	139	148	103	84
Doctorate .	179	198	218	170	173

TABLE A-3.8--Continued

Educational Attainment (1962)	Engineers	Physical Scientists	Biological Scientists	Mathematicians	Social Scientists
	c) Index of Academic Concentration				
Bachelor's .	.86	.73	.78	.48	.30
Bachelor's plus . . .	.77	.68	.65	.45	.39
Master's . .	.76	.75	.78	.54	.45
Doctorate .	.72	.84	.84	.73	.68

N	702,987
NA, other	69,879
Degree exclusions . .	381,641
Total N	1,154,507

TABLE A-3.9

INDEXES OF ACADEMIC CONCENTRATION FOR FIELDS OF SPECIALIZED STUDY FOR ALL DEGREES HELD BY SEX, EDUCATIONAL ATTAINMENT (1962), AND OCCUPATION GROUP (1960)

Educational Attainment (1962)	Men				Women			
	Physical Scientists	Biological Scientists	Mathema-ticians	Social Scientists	Physical Scientists	Biological Scientists	Mathema-ticians	Social Scientists
Bachelor's . . .	.73 (29,411)	.80 (4,076)	.46 (4,610)	.30 (3,999)	.79 (2,825)	.66 (1,286)	.53 (2,394)	.30 (2,130)
Bachelor's plus .	.66 (23,333)	.68 (2,995)	.46 (4,325)	.37 (4,869)	.77 (1,598)	.48 (721)	.44 (963)	.49 (1,270)
Master's	.74 (22,280)	.81 (6,767)	.55 (7,366)	.50 (15,766)	.77 (1,795)	.62 (1,114)	.55 (1,648)	.34 (7,115)
Doctorate	.84 (23,396)	.75 (9,820)	.73 (4,514)	.66 (20,705)	.72 (659)	.86 (687)	.78 (276)	.65 (3,427)

N	218,140
NA, other	34,328
Degree exclusions . .	22,297
Total N	274,765

TABLE A-3.10

INDEXES OF ACADEMIC CONCENTRATION FOR FIELDS OF SPECIALIZED STUDY FOR ALL DEGREES HELD, BY AGE (1962), EDUCATIONAL ATTAINMENT (1962), AND OCCUPATION GROUP (1960)

Educational Attainment (1962)	Engineers			Physical Scientists			Biological Scientists			Mathematicians			Social Scientists		
	25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54	25-34	35-44	45-54
Bachelor's	.87	.88	.82	.72	.72	.78	.76	.83	.78	.59	.40	.24	.34	.22	.30
N	88,655	104,915	35,313	12,264	11,906	4,524	1,931	1,844	782	3,340	1,599	898	2,352	1,602	1,064
Bachelor's plus . . .	.81	.79	.71	.74	.60	.63	.66	.62	.66	.61	.41	.38	.45	.41	.36
N	53,409	56,378	21,706	9,468	9,231	3,900	1,243	1,100	858	2,514	1,373	670	2,088	1,647	1,071
Master's .	.78	.77	.64	.80	.73	.67	.82	.77	.71	.59	.51	.55	.51	.51	.34
N	26,556	26,707	9,543	8,738	8,465	3,819	2,597	2,816	1,330	3,468	2,679	1,571	7,082	7,551	4,497
Doctorate .	.75	.81	.49	.86	.82	.87	.85	.86	.83	.78	.69	.74	.82	.68	.66
N	3,086	4,355	1,581	6,238	10,552	4,088	2,245	4,556	2,095	1,369	1,633	1,032	3,891	9,736	5,858

N	619,379
NA, other	54,827
Age and degree exclusions . .	480,301
Total N	1,154,507

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